The FOUNDRY

Volume 58
Number 17

Published
Semimonthly

CLEVELAND, OHIO, SEPTEMBER 1, 1930

When a Stone Is Not a Stone Look to the Foundry

MANKIND has made more progress in the last 400 years than in any other period of history. The first book was issued from the printing press some 425 years ago and that event was perhaps the most important in the history of the human race for it marked the end of the dark ages.

Composing Rooms Now Have Cast Iron Stones

Had Johannes Gutenberg and his contemporaries in the printing art lived 100 years later it is probable that the progress of mankind would have been delayed by just that period. The principles upon which printing is based are ancient in point of origin. Printing from movable type probably was practiced to a limited extent in the twelfth century in China. The great invention was that of forming every letter separately so as to be capable of rearrangement. This rearrangement of the pieces of type is carried out on a composing stone where the printer assembles the page of type before sending it to the press. But, the *stone* is no longer a stone; it is casting. Modern printing shops are discarding the heavy, cumbersome flat stones, and are substituting carefully finished cast iron *stones*. Thus, improvement in printing technique adds a new market for castings.

Find Where Castings Can Be Sold

CONTENTS

FEATURE ARTICLES

	Page
Aluminum Has Important Part in New Buildings	90
Gray Iron Posses Valuable Engineering Properties—Part VIII	94
Surveys Foundry Industry in Czechoslovakia—By Fr. Pishek	98
Heat Treatment Determines Properties of Manganese Steel—By Harry P. Evans	102
Ohio Group Meets at Cincinnati	103
Casts Pipe Vertically in Sand—By Pat Dwyer	104
Preventing Unsoundness in Bronze and Red Brass—Part II	108
Fundamentals of Foundry Practice—Part XVII—By Ivan Lamoureux	112
Bill Tells of Molding a Smokestack—IV—By Pat Dwyer	121

REGULAR DEPARTMENTS

The Foundry Family Photograph Album	115	**Comings and Goings of Foundrymen**	125
The Foundry Data Sheet	116	**Foundry Association Directory**	126
Questions and Answers on Foundry Practice	117	**Trade Trends in Tabloid**	129
Problems in Nonferrous Founding — By Charles Vickers	120	**What the Foundries Are Doing**	130
The Shakeout	124	**New Trade Publications**	130

PUBLISHED BY THE PENTON PUBLISHING CO.,
Penton Building, Cleveland, O.

BRANCH OFFICES

CHICAGO.....1347 Peoples Gas Bldg.
CINCINNATI.....209 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....507-508 Oliver Bldg.
SAN FRANCISCO.....24 California Street
WASHINGTON, D. C. .....1020 National Press Bldg.
LONDON, ENGLAND.....416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND.....14 New Street
PARIS, FRANCE.....No. 9 Rue de Londres
BERLIN, GERMANY.....Dahlmerstrasse 64A, Berlin Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico .....$3.00 a year
Canada .....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single copies .....25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified subscribers, and honest advertising of dependable products.

Copyright 1930 by the Penton Publishing Co.

Aluminum Has Important

in New Buildings

CERTAIN inherent characteristics of aluminum make this metal particularly adaptable for architectural purposes. Chief among these is the resistance to atmospheric corrosion. The use of aluminum frequently is dictated by the many forms in which it may be obtained, its ready workability and its lightness. No paint is required to preserve aluminum. However, where a coat of paint is necessary to carry out some definite color scheme, it is claimed that aluminum offers two advantages for a base. In itself it may serve as one of the colors in a combination effect. It resists atmospheric corrosion and therefore the paint is not dislodged from underneath.

Most of the ornamental aluminum castings are cast from an aluminum-silicon alloy containing 5.00 per cent silicon. Virgin metals of low iron content are preferred, because of fluidity at low temperature. Shrinkage and contraction are less than in other aluminum alloys. With this combination of favorable properties, it is possible to pour intricate castings having both thin and thick sections without excessive use of chills and risers and to obtain in the castings, sharpness and refinement of detail.

Typical castings formed from this alloy include spandrels, mullions, window sills, copings, roof cornices and crestings, facias, grilles, radiators, covers, statues and other castings employed primarily for decorative effect. The metal lends itself readily to this purpose on account of the number of different finishes and combinations which may be obtained.

The natural finish of a casting as it comes from the sand is that of silver with a slight tinge of blue. After the casting is polished, the blue tinge becomes more pronounced and the surface has a greater reflectivity for light. Sandblasting produce a matte finish resembling etched glass and reduces the reflectivity. A darker shade of gray is obtained by employing a carborundum blast, due to the fact that small carborundum particles are deposited on the face of the casting. Application of a wire brush and emery cloth will produce a satin finish on aluminum comparable to Roman gold on gold.

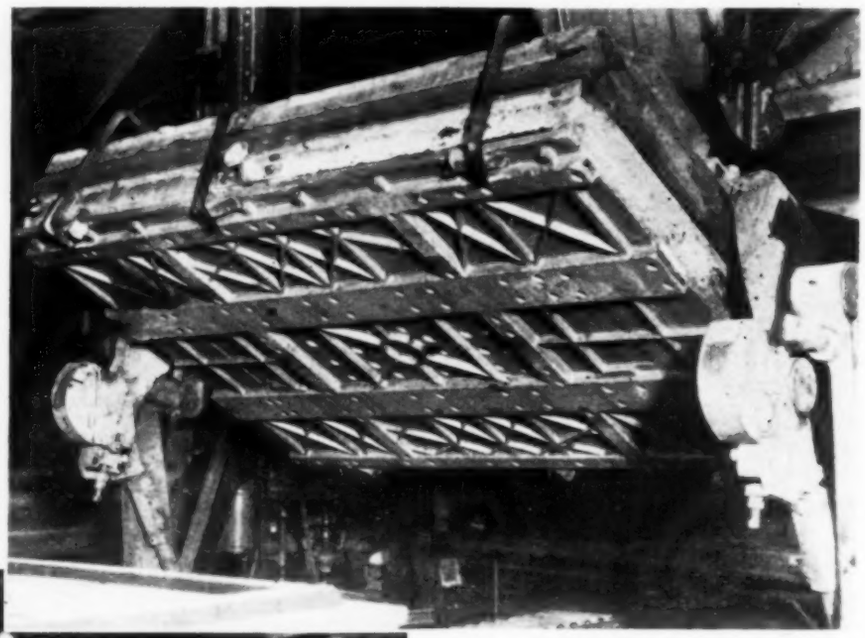


Fig. 2—(Above)—Bottom Plates on the Spandrel Mold Drags Are Planed on Both Sides and Are Heavily Reinforced

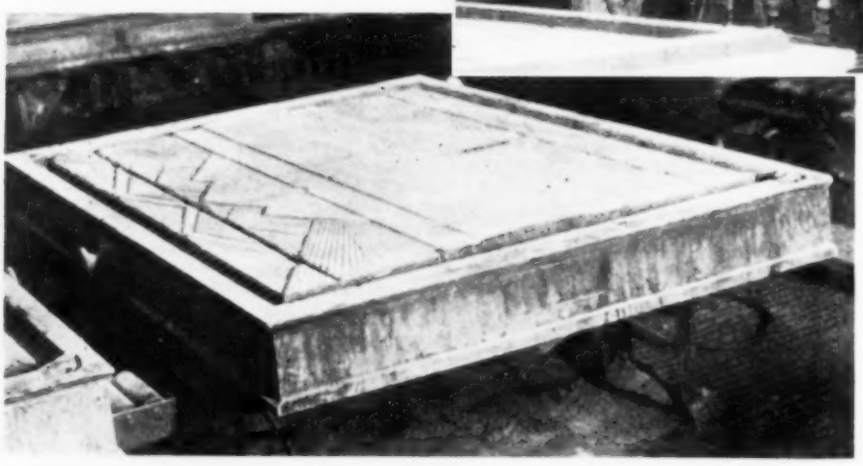
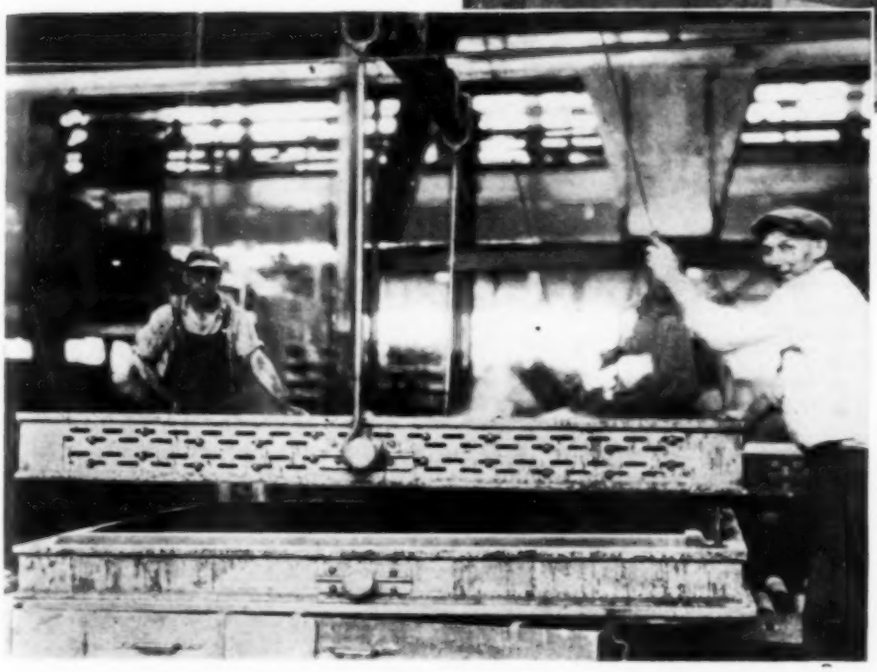


Fig. 1—(Below)—Copes Are Laid on Their Backs, Finished and Lightly Sprayed with Molasses Water

Varying shades of gray and a

Part

Fig. 3—(Below)—Accurately Machined Guide Pins and Sockets in Opposite Corners Serve To Locate the Copes Upon the Drags. The Flasks Are Interchangable and the Pins Are Removed After Each Mold Is Closed. Fig. 4—(Right)—Casting and Sand Are Spilled Onto a Grating. The Bottom Plate Is Turned Over and Returned To the Molding Station



surface resembling stone may be obtained by deplating aluminum-silicon alloy castings. The process corresponds approximately to the anodic treatment of aluminum and is the reverse of plating. Briefly, a large capacity electro-plating apparatus is employed with the casting to be treated as the positive electrode and a slab of pure aluminum as the cathode. A weak solution of sulphuric acid serves as the electrolyte. When electrolysis takes place, aluminum is removed from the surface of the casting and the silicon particles are left exposed. Oxygen forms at the positive pole and as a result, the surface of the casting becomes oxidized. The surface thus obtained is treated further to increase its resistance to corrosion. The color of silicon is a dark, velvety gray, resembling that of lead. By varying the current densities and the time, different shades of gray may be obtained.

At a distance, the color of window glass resembles that of carborundum blasted or deplated aluminum castings. Spandrels finished by either of these methods, merge with the windows and appear as a uniform gray line. An ordinary unfinished aluminum casting will assume the same color after it has been exposed to the weather for some time. Weathering is responsible for the change to some extent, but the change in color is due principally to deposits of dust and soot from the atmosphere. A polished or smooth surface will remain brighter for a greater period of time than will a casting with a natural or rough surface.

A considerable volume of architectural castings is handled by the United States Aluminum Co., Cleveland, a pioneer in this line and one that has developed many interesting features in the production of aluminum alloy castings for many purposes hitherto considered the exclusive fields for other metals.

The Cleveland foundry has a daily capacity of 200 to 300 spandrels, depending on the size. This capacity readily may be increased by small addition to present equipment. Up to the present the largest spandrels have measured 4½ x 10 feet. One section of the foundry 50 x 50 feet has been equipped in a special manner for the rapid production of these castings. Sand is supplied from overhead hoppers. The molds are assembled and poured on a conveyor line and the empty flasks are returned to the molding machines on a second roller conveyor line which parallels the first. With the exception of the

Fig. 5—Metal Is Poured Into the Mold Simultaneously from Two Crucibles

molding machines made by the Herman Pneumatic Machine Co., Pittsburgh, all the equipment was fabricated and installed by the company's own staff.

All the flasks are aluminum, machined on both faces, drilled on sides and ends for trunnions, and with copes and drags of any one size, interchangeable through hardened steel bushings accurately machined and fitted *inside* two opposite corners as shown in Fig. 9. The bushing in the drag projects above the joint to engage the corresponding bushing in the cope, also to locate the flask properly on the pattern board. Long, tapered steel pins are erected on the drag temporarily during the process of lowering the cope into place. After the cope and drag are clamped together, the pins are removed and placed in the next flask on the conveyor line.

The total number of flasks required, is held to a minimum by the adoption of the roller conveyor and continuous pouring system. Each flask makes the cycle from shakeout to shakeout about once every hour during the working period. The complicating factor introduced by changing patterns is met by equipping the copes with detachable bars. The side of the cope, as may be noted in Fig. 3, is pierced with four rows of ¾ x 3-inch staggered slots through which the bars may be bolted in widely varying combinations.

Gaggers Do Not Project

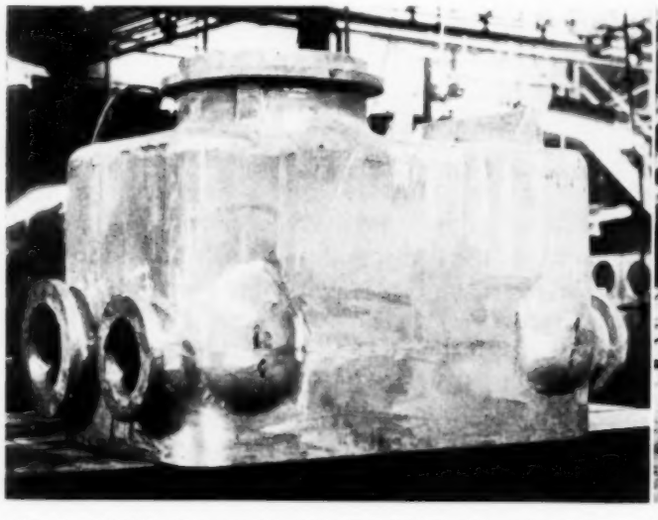
Separated from the face by less than ½-inch of sand, the bars follow the contour of the pattern closely. The sand between the bars is reinforced by light, twisted gaggers set close to each other. At one stage of its progress, during the finishing period, the cope, resting on its back, rolls along the conveyor and for that reason, neither gaggers or bars are allowed to project above the surface.

On account of its comparatively low specific gravity, molten aluminum does not exert the same pressure as iron, steel or brass against the upper and lower faces of the mold. However, even with this light metal a certain amount of pressure is inevitable and the mold must be constructed to resist it. The specifications for the castings are unusually exacting on weight and thickness. The customer wants his full 3/16-inch thickness and the producer naturally objects to the donation of extra metal. Under these conditions exceedingly skilful foundry practice is essential. Strong and accurately fitting equipment is not a luxury but a necessity.

Tendency of a large unsupported cope face to sag is prevented by the bars spaced on 8-inch centers and extending from side to side of the cope where they are bolted rigidly. The same agency that prevents the sand from sagging through gravity, also prevents it from rising when subjected to the pressure of the molten metal when the mold is filled.

Distortion of the casting in the drag is prevented by a heavily reinforced bottom plate which holds the sand securely in position. Detail of the construction of this thick, one-piece aluminum plate is shown in Fig. 2. It is reinforced on the bottom side by four longitudinal and two transverse main battens, supplemented by many smaller ribs in the spaces between. The main battens are hollow and thus conserve metal to some extent without any reduction in strength. The face of the plate and the faces of the battens are planed.

Patterns for spandrel castings are made of wood, of plaster, or a combination of both. Where plaster is employed, it is backed by a substantial wood frame. An entire wood pattern is reinforced in the same manner. In either case, two patterns are required, one for the cope and one for the drag. A pattern conforming exactly to the shape and thickness of the proposed casting would be too fragile for foundry use. The two working pat-



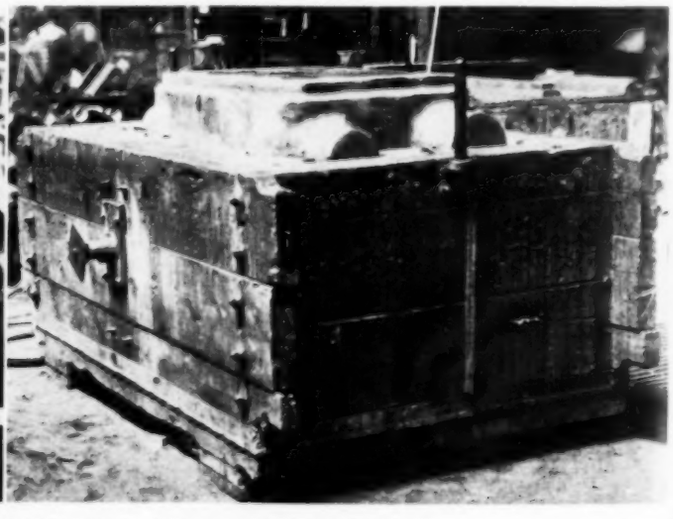


Fig. 6—(Left)—Large Aluminum Casting for Transformer Installation. Fig. 7—(Right)—Mold and Core for the Same Casting—The Upper Part of the Core Was Made in Green Sand

terns in effect constitute the two sides of a matchplate, mounted independently on strongly constructed pattern boards. The drag molds are rammed on one and the cope molds are rammed on the other. Manifestly, absolute accuracy is involved in their construction to insure a uniform thickness of metal in the resulting casting and a closely fitting joint where the sands of the cope and drag, come into contact.

On account of the comparatively low temperature of the metal and the short time it is in contact with the sand, the problem of reconditioning the sand is comparatively simple. When the molds are shaken out the sand falls through a grating in the floor which catches the gaggers as shown in Fig. 4. A belt under the floor carries the sand to the mixing plant where it is screened, aerated, sprinkled with water and discharged upon a belt which carries it back over a series of hoppers erected over the molding machines. Experience has shown that a moisture content of 4 per cent, yields the most satisfactory results in the molds. To compensate for this rather dry condition of the sand, the face of each mold is sprayed with molasses water and lightly dusted with powdered talc.

Adapt the Equipment

The roller conveyor line on which the flasks and bottom plates are returned to the molding stations is on the outside of the row of columns bounding the section of the floor given up to the production of the spandrel castings. Consequently the traveling crane cannot be utilized for placing the flasks on the molding machines, or the bottom plates on the drags. A length of 6-inch I-beam pivoted at one end to a building column and supporting a small electric hoist, serves admirably to handle the flasks and bottom plates. A smaller beam attached in a similar manner to a second column supports a mechanically operated sieve which distributes sand over the face of the pattern.

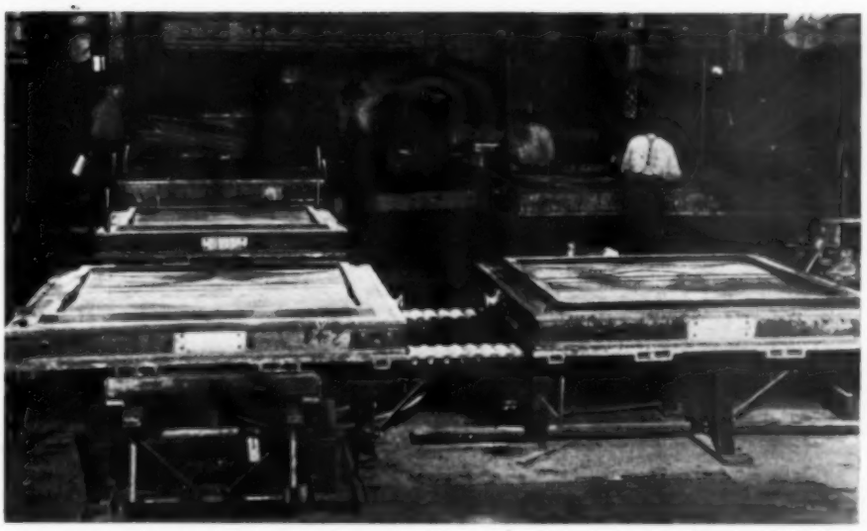


Fig. 10—The Molds Are Moved on Roller Conveyors from the Molding Machines to the Pouring Station, Thence To the Shakeout and Back To the Molding Station

In practice, the drag is lifted by the small jib crane and placed on the pattern board attached to the table of the molding machine. Sand is shoveled into the sieve which easily is moved from point to point over the pattern. When the pattern is covered to a depth of approximately ½-inch, the sieve apparatus is pushed out of the way and the gate of the overhead sand hopper is opened. A 2 x 10-inch plank is placed across the flask temporarily to break the fall of the sand and thus prevent uneven density over the face of the mold. After the drag has been filled partly the plank is removed, and sufficient sand is allowed to fall from the hopper to over-top the drag by several inches.

The mold is then jolted a predetermined number of jolts after which the surplus sand above the flask is removed with a steel straightedge. A thin coating of loose sand is sprinkled over the surface to insure a close contact with the bottom plate which is lifted from the roller conveyor by the jib crane, placed on the drag and clamped in place. The drag then is rolled over and deposited on a short roller conveyor leading to the long conveyor which parallels the gangway. The clamps are released and the machine swings the pattern board and pattern back to its first position on the ramming table. Here the cycle is repeated.

The process practically is the same with the cope which is made on a similar machine separated by a short distance from the first. After the first coating of sand is sieved over the pattern, rows of gaggers are set up between every pair of bars. The gaggers are of light twisted stock, bent in the form of a *U* with toes at each extremity.

Poured Two-Up

Metal is poured through two upright runners, one on each side of the cope at the center. Each upright runner is reamed out at the top to receive the metal readily and terminates at the bottom in a channel which extends the entire length of the mold. Wide, thin gates spaced from 4 to 6 inches apart connect the channel with the mold cavity. The general arrangement of the gates is illustrated in Fig. 4.

(*Concluded on Page* 101)

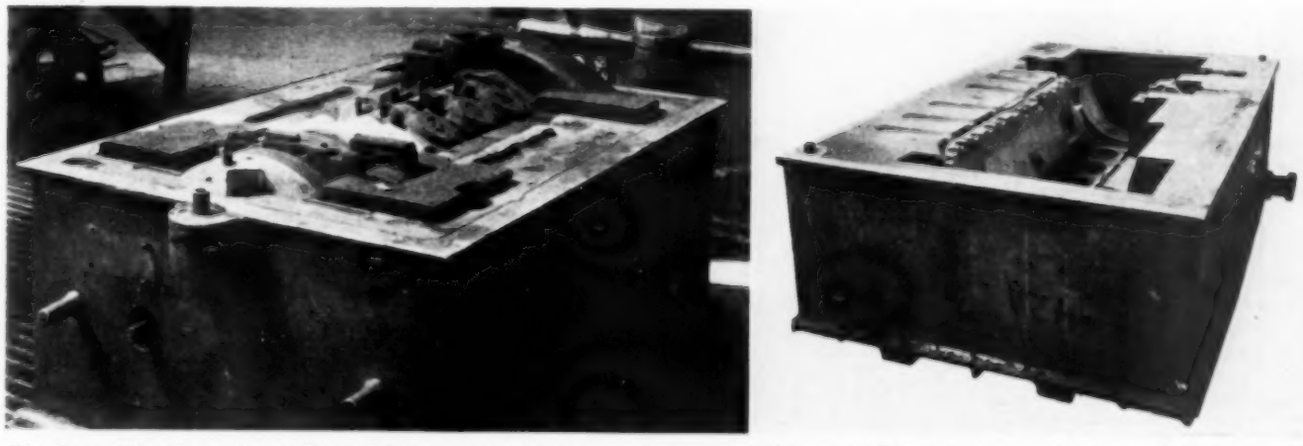


Fig. 8 and 9—Green Sand Drag Mold for Crankcase as it Appears With and Without Cores. Many of the Cores Also Are Green Sand

GRAY IRON

Possesses

Valuable Engineering Properties

Part VIII

MAURER and Holtzhaussen in *Stahl und Eisen* Oct. 27 and Nov. 24 1927 attempted to extend the original Maurer constitutional diagram to take into account variations in rate of cooling. They varied the cooling rates by pouring some of their bars into heated molds, the temperatures employed being 482 degrees Fahr. The results of these tests are indicated in Fig. 63. The bars cast in cold molds pass from the pearlitic to the mottled region at higher silicon values than indicated in original diagram which probably coincides better with American experience. The bars cast into molds heated to 482 degrees Fahr. coincide with the original diagram while those cast in molds heated to 842 degrees Fahr. require the pearlitic field to be displaced to the left by 0.5 per cent silicon.

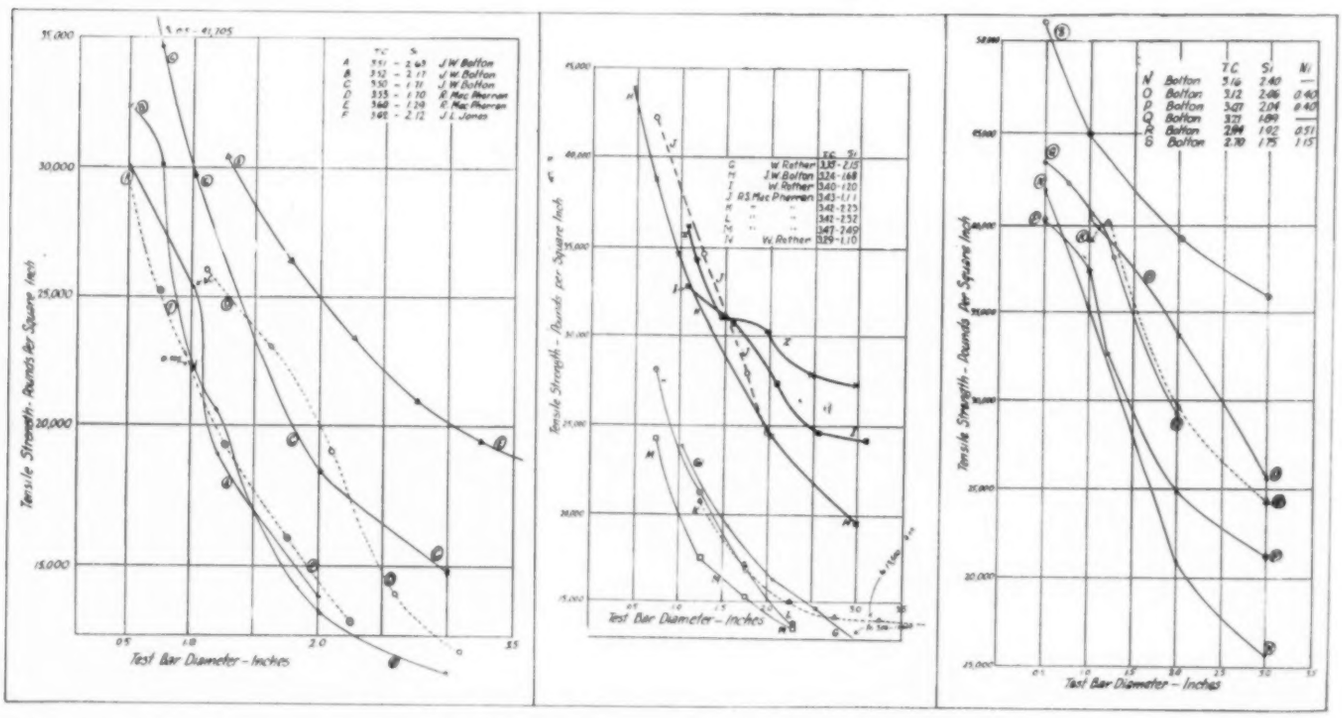
In the region of higher total carbon contents it was found that the lines on the diagram required bending upward, thus making the pearlitic area larger, as indicated in Fig. 63. Maurer and Holtzhausen calculated that the molds heated to 482 degrees Fahr. retarded cooling to give a cooling rate approximating that of a 3-inch bar cast in the ordinary manner, and the mold heated to 842 degrees Fahr would give a rate like that in a 3.6-inch bar. That gives the shaded area in Fig. 63 as the common pearlitic region for castings (or test bars?) between 0.4 and 3.5-inches thick. These results remain to be verified by other investigators.

Having given some attention to the workings and possible good points of the various formulas and diagrams based on direct correlation of physical and structural properties to analysis, let us go further. How important are the neglected factors?

John Shaw, Southsea, England, provides an interesting set of data. He took a suitable pig iron of known composition, put it through a small cupola, and made 1.25 x 1.25 x 14-inch test bars from the mixture. On subsequent mixtures he added steel, 12 per cent silicon pig, ferromanganese, changed coke ratios, cut the blast, and varied other factors to maintain nearly uniform analysis. He finally ran up to 80 per cent steel. Shaw offers the following to indicate the importance of factors other than analysis and section size. The

Apply Shear Test

WHILE investigators have tried to make changes in their formulas to fit the varied conditions encountered in practice, considerable care and caution must be exercised in applying them. Another method for determining the properties of gray iron is the shear test which has been proposed by the French. An interpretation of the test and the drawbacks that may be encountered are presented in this article which is the eighth of a series on gray iron properties. The seventh article appeared in the Aug. 1 issue.


Tensile Strength - Pounds per Square Inch
Test Bar Diameter - Inches
Tensile Strength - Pounds per Square Inch
Test Bar Diameter - Inches
Tensile Strength - Pounds per Square Inch
Test Bar Diameter - Inches

Figs. 60, 61 *and* 62—*Curves Showing the Relation Between Tensile Strength and Test Bar Diameter from Data Obtained from Various Sources*

average tensile strength of five low bars containing 1.76 per cent silicon; 3.39 per cent total carbon, and 0.55 per cent combined carbon was 23,900 pounds per square inch. The average tensile strength of five high bars containing 1.70 per cent silicon; 3.37 per cent total carbon, and 0.58 per cent combined carbon was 39,500 pounds per square inch.

He draws the conclusions that with analysis and section size constant physical properties depend on makeup of charge, cupola practice, and casting temperature, with which agreement readily will be made.

Compares Cooling Effect

W. J. Love experimented leaving test bars in the sand until cooled versus pulling them out of the sand as hot as possible. Averages of five sets of bars are: Pulled from sand hot, 28,100 pounds per square inch; pulled from sand cold, 23,395 pounds per square inch. Those data prove conclusively that it is impossible to apply the previously given formulas in a practical way unless unmeasured conditions are maintained approximately constant, and even under these conditions formulas indicate only average properties to be expected from irons made under similar conditions.

Let us consider the application of formulas to computing effects of cooling rate (section size) on tensile strength. F. B. Coyle made a study of certain curves indicating the relationship between tensile strength and test bar diameter on bars of like analysis. He found that some of these curves are of the type:

$$y = C\ x_m \qquad \text{(Equation 1)}$$

where y = tensile strength; C = a constant; x = diameter of bar, and m = an exponent. This equation can be expressed in logarithic form as follows:

$$\log y = m \log x + \log C \qquad \text{(Equation 2)}$$

When Equation 1 is plotted on logarithmic cross-section paper the curve becomes a straight line. Since Equation 2 is then a standard form of straight-line equation:

$$y = mx + C \qquad \text{(Equation 3)}$$

If this equation could be shown to apply in all cases, it would be possible to predict the strength of any size section from the results on a single size test bar once the proper constants were determined.

That scheme, employing data obtained by R. S. MacPherran, W. Rother, J. W. Bolton, and the late J. L. Jones, has been investigated, and the complete data are shown in Table VII. This table also is of value for direct comparisons of analyses and strengths as well as for checking the formula. The complete data charted on curves is shown on Figs. 60, 61, 62, 65 and 66. These curves plotted on logarithmic paper are shown in Fig. 67. Several of them are practically straight lines within the limits of the analytical data given. Others show a

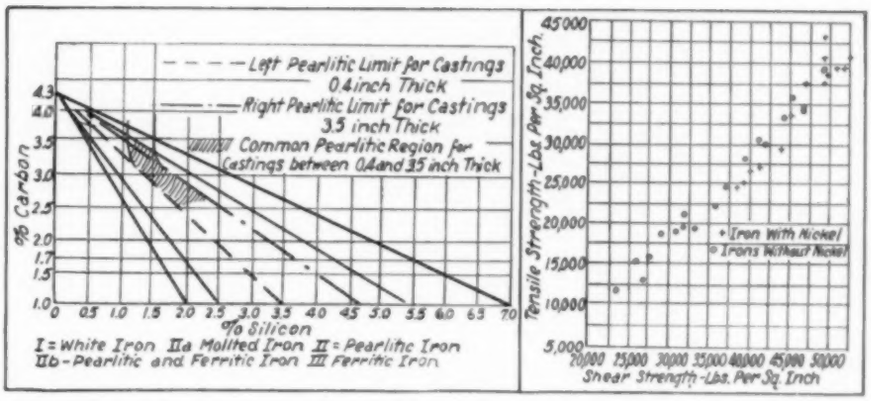
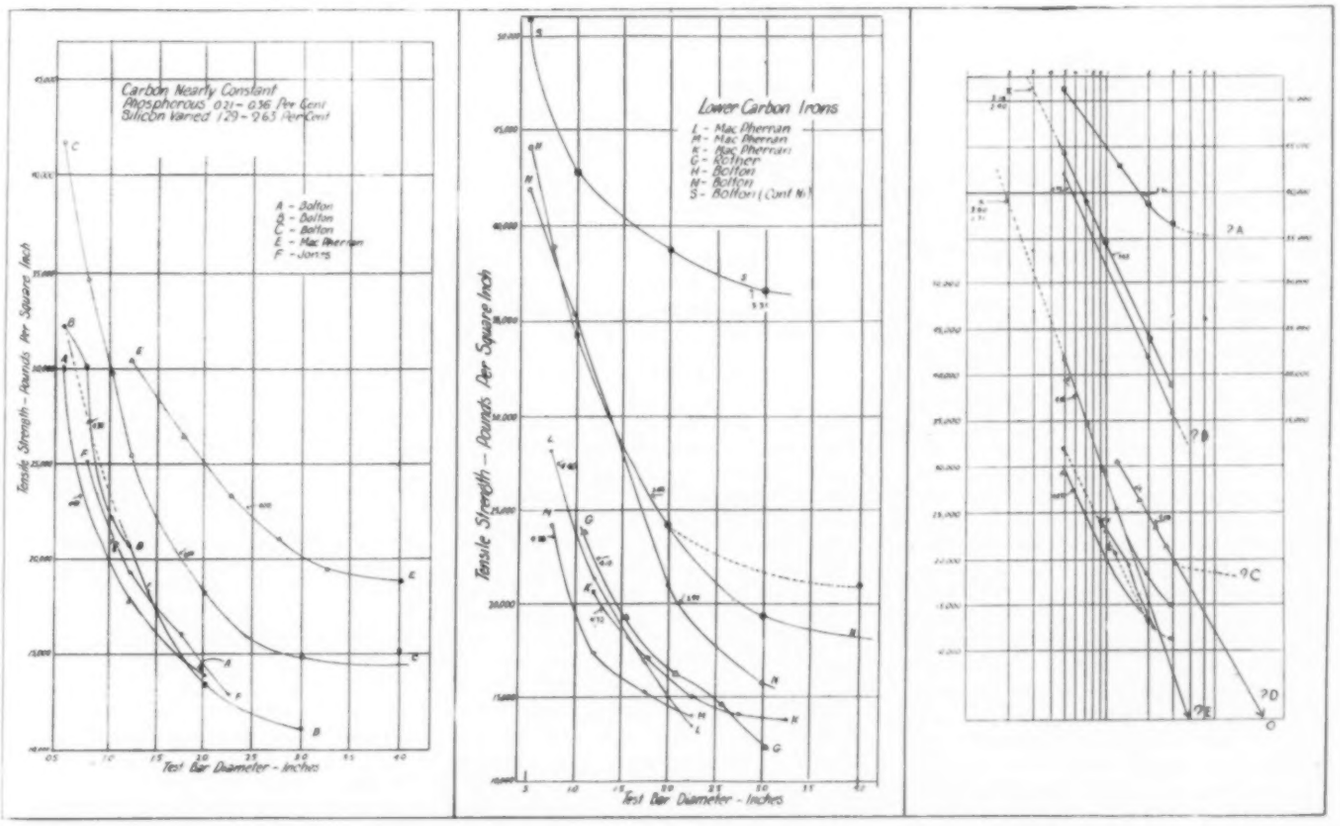

Left Pearlitic Limit for Castings 0.4 inch Thick
Right Pearlitic Limit for Castings 3.5 inch Thick
Common Pearlitic Region for Castings between 0.4 and 3.5 inch Thick
% Carbon
% Silicon
I = White Iron IIa Molited Iron II = Pearlitic Iron
IIb - Pearlitic and Ferritic Iron III Ferritic Iron
Tensile Strength - Lbs. Per Sq. Inch
Shear Strength - Lbs. Per Sq. Inch
+ Irons With Nickel
○ Irons Without Nickel

Fig. 63—Maurer's Diagram Extended to Include Variations in Cooling Rate
Fig. 64—Relation of Shear to Tensile Strength on 0.505-inch Test Bars



Figs. 65 and 66—Relationship Between Tensile Strength and Test Bar Diameter. Fig. 67—Data Plotted on Logarithmic Paper Show Straight Lines

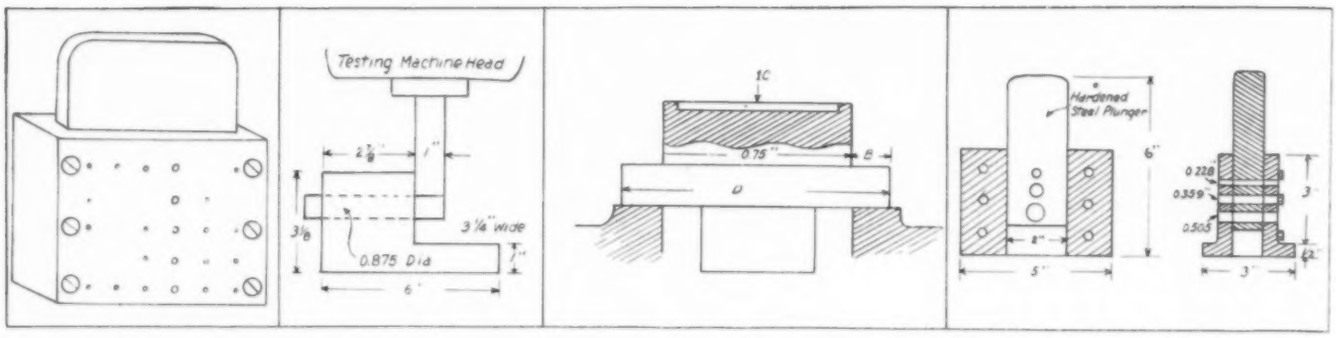


Fig. 68—Elliott's Single and Double-Shear Block. Fig. 69—Rother's Single Shear Block. Fig. 70—Rudeloff's Shear Testing Device. Fig. 71—Bolton's Device for Shearing Bars of Different Diameters

definite knee or curve toward the right.

Those curves which show up as a straight line instantly indicate the limitation of this formula for the purpose suggested for by projection they indicate that the material would approach zero strength. Projections *B* and *E*, for examples. However projections *A* and *C* indicate the probable true state of affairs. It is well known that above certain section sizes all gray irons tend to approach constant strengths, rather than to approach zero strength. Constant strength is approached when the particular iron is in approximate thermodynamic equilibrium — i. e. when it is entirely graphite and ferrite, and approximately constant in grain size. The strength then is largely dependent on the amount of graphite present, the grain size, the nature of the silico-ferrite matrix, and the freedom from shrinkage. Neglecting the latter three factors, the strength is in inverse ratio to the total carbon originally present, as all of this now has been converted into graphite.

May Eliminate Mystery

Notwithstanding the limitation of this formula it is believed that it has great possible significance, in that it may enable formulation of a definite law for rate of graphitization—and when the exact laws of graphitization are on a quantitative basis much of the mystery will disappear from gray iron metallurgy. Within the ranges in which graphitization is proceeding the curves do become straight lines, further, the lines for the different irons are not far from parallel. Here is a fruitful field for the patient investigator.

Previously, a few of the numerous formulas which seek to predict physical properties of cast iron from the analysis, and one formula which is intended to evaluate the effect of cooling rates have been mentioned. No formulas have been advanced to take into account the makeup of charge, influence of melting process, and effects of design and foundry practice. Any universal formula must take all these into account. There have been a number of formulas advanced in which attempts are made to predict an unknown physical property from a known one, that is: Convert brinell to tensile; transverse to tensile; tensile to compression, and shear to tensile. These will be covered separately under the headings of the particular physical tests involved.

It is not hard to see that all the formulas discussed have serious limitations which prevent their general application. One may well ask why bother with formulas if they are not practical. True enough, formulas should not be handed out promiscuously as shortcuts to the more direct and expensive but accurate methods of actual testing. However, formulas do serve a vital need. They are a means for correlation of research. Haphazard and disconnected investigations are of slight value. It is only when data are assembled and co-ordinated that their significance becomes apparent, that laws and generalizations of practical value can be made. Formulas are among the ultimate ends of co-ordination. Since the first formulas are incomplete, they must be accepted with caution. However, they already are pointing out the proper methods to use in further investigations. Therefore, the foundrymen and the metallurgist should grant some attention to formulas and not be too ready to condemn them.

Propose Shear Test

During the past few years the shear test for cast iron has been mentioned frequently in the literature of foundry metallurgy. This test has been and is being ardently advocated as a standard method of arbitration test by certain Continental engineers, particularly by the French. British metallurgists have opposed the routine use of this test vigorously. While it has not been widely used yet in this country, the possibility of its use in specification work should attract the attention of all American foundrymen and metallurgists. If adopted as a standard test, what are its commercial applications? If unsound as a testing method, why? Is it adapted to routine testing or only to certain research work?

According to leading proponents of this method samples can be trepanned from relatively unimportant places in castings and tested in shear, affording a direct and simple test of the properties of the metal in the casting. Suffice to say that due to this method of trepanning the specimen without further preparation, an accurately prepared smooth test piece did not result. Further, the machine itself (as delivered to the American Foundrymen's association) was not rigidly and accurately enough constructed to eliminate bending moment during shear testing. Therefore, results were not entirely satisfactory.

Investigate Test Method

The Fremont machine was investigated carefully by Willard Rother, and the late George K. Elliott. *Transactions* of the American Foundrymen's association, 1926. Their results (confirmed by other investigators) indicate that this machine lacks the rigidity, accuracy, and constancy of calibration essential in a good testing machine.

The French proposed to trepan specimens from actual castings by means of a hollow drill. Test specimens obtained in this manner were rough in finish and of uncertain diameter. Obviously these could not fairly represent the properties of a relatively brittle material such as gray iron, for shearing stresses would be accompanied by transverse stresses and low and erroneous results would result. For accurate shear testing the test piece must be absolutely uniform in diameter and fit the holes in the test blocks closely. Any inaccuracy, give, or spread in the test blocks will give false results.

As result of his tests Elliott recommended the single or double shear testing block and plunger shown in Fig. 68. Pressure is applied to the drilled plunger by a universal testing machine. The device is particularly valuable for double shear. W. Rother designed a single shear

setup for use in a universal testing machine shown in Fig. 69.

Dr. Rudeloff, *Stahl und Eisen*, Jan. 28, 1926 experimented with what is termed a "hole shear test" (Fig. 70). The test specimen *D* is placed over a cylindrical shearing die. The portion below *D* merely serves to center the specimen. The action of the applied force (1C) shears the specimen. Thus the action of the force applied to the narrow ledge of the flange test specimen *D* shears off an outer ring of internal diameter 0.75-inch and width *B*. The test was found not to give true shear action. In a later paper, *Die Giesserei*, Aug. 14 and 26, 1926, he attempts to correlate these shear tests with other mechanical tests of cast iron, and disagrees with results by other investigators.

Use Different Size Bars

In 1928 Bolton had constructed the device for making shear tests shown in Fig. 71. As shown in the sketch the device can be used for testing bars of 0.226, 0.359 and 0.505-inch in diameter. These correspond to cross sectional areas of 0.04, 0.10 and 0.20 square inches respectively. Double shear was employed, test bars were ground accurately to size and loading was done on a universal testing machine. This device gives closely checking results.

The relationship of shear to tensile on these tests is shown in Fig. 64. The chart indicates a nearly constant relationship. However it must be borne in mind that these tests are all on gray irons with rather low phosphorus content. Shear tests made on different sized test pieces from the same test bar differ materially, the smaller pieces giving lower results.

Various investigators results using different apparatus, types of irons, and sizes of bars do not indicate any constancy in shear tensile relationship. For example:

Fremont states shear test results equal tensile test results.

Ronceray states shear test results equal tensile test results.

Siegle gives the shear to tensile ratio as 1.2 to 1.4 on gray irons. He found no relation on mottled and white irons, shear being high and tensile low.

Elliott found the shear to tensile ratio to be 1.14 to 1.31.

Rother's test indicated a shear to tensile ratio of 0.75.

LeThomas states the shear tensile ratio is 0.9 to 1.0.

Audo gives a shear to tensile ratio of 0.916 to 1.20.

Bolton's results indicate shear approximates tensile plus 9000.

Rudeloff's tests, made in quite a different manner, as indicated previously found ratios of 0.67 to 0.64 using different sizes of test pieces.

English workers found ratios from 1.00 to 1.80.

Values Run Higher

On logical grounds shear tests should run consistently higher than tensile tests. These higher values are to be expected in true shear because of the action on the graphite flakes. In true tension these flakes offer little resistance to the stresses. In shear, on the other hand, the flakes are in compression and offer considerable resistance to the stress. Within the limits tested by Bolton there is a close relationship between shear and tensile. Shaw has pointed out that this relationship holds only in gray irons, and those low in phosphorus. In chill or white irons, or in high phosphorus irons this relationship does not apply. Further, as might be expected bars 0.505-inch in diameter give higher shear stresses than the smaller sizes.

Before the foundryman and engineer can give serious consideration to the shear test, the limitations inherent in the method and in the test procedure should receive careful scrutiny by leading testing societies, and standard conditions specified.

Consider Commercial Phase

Aside from the technicalities of testing method, there remains the commercial angle to be considered. The French propose that the properties of the casting be judged by a test bar about the diameter of a pencil and less than half as long. It is desirable to give the purchaser of the casting some assurance of quality of metal contained therein. Will the shear test do this? There is considerable doubt on that point as may be seen from the following opinions:

George K. Elliott said, "The writer's judgment is not entirely favorable to the Fremont shearing test as a routine test * * he is kindly disposed to it as a means to a much needed line of research. The care and time necessary to secure reliable samples

(*Concluded on Page* 101)

Table VII

Data on Dimensions and Compositions of Specimens

No.	Composition				Diameters of Test Specimens in Inches									
	C	Si	P	E.C.	0.50	0.75	1.00	1.2 and 1.25	1.75	2.00	2.25-2.50	2.75-3.00	3.25-4.00
A	3.51	2.63	0.26	4.41	*30,100		*25,426	18,000		14,000			
B	3.52	2.17	0.32	4.30	32,217	30,243	22,205	20,082		13,485		11,561	
C	3.50	1.71	0.36	4.16	41,705	34,718	29,885	25,478		18,455		15,056	15,580**
D	3.53	1.70	0.44	4.24			{25,940 {1.08 diam.		{23,200 {1.60 diam.	19,200	14,150	12,000	
E	3.60	1.29	0.21	4.08				30,500	26,500		23,500	21,250	19,750-19,250
F	3.62	2.12	0.37	4.43		25,360		19,450	16,200		13,040		
G	3.35	2.15	0.47	4.18			{23,780 {1.06 diam.		{19,290 {1.57 d.	{16,330 {2.07d	{14,580 {2.56d	{12,640 {3.06d	
H	3.24	1.68	0.33	3.83	43,971	38,860	34,575	34,457		{24,248 {2.04d		19,519	***21,350
I	3.40	1.20	0.31	3.88			{32,830 {1.07d		{30,930 {1.60 diam.		{27,350 {2.57d	{24,520 {3.10d	
J	3.43	1.10	0.21	3.84		42,170		34,600	27,800	24,470			
K	3.42	2.23	0.54	4.32				20,750	17,000		15,000	14,250	14,000
L	3.42	2.32	0.65	4.40		28,100		21,140	16,770		13,570		
M	3.47	2.49	0.37	4.38		24,250		17,380	15,310		13,560		
N	3.16	2.40	0.27	3.99	41,887		35,380			21,060		15,903	
O	3.12	2.06	0.31	3.86			40,162	39,068[1]		33,860		25,803	
P	3.07	2.04	0.24	3.77	40,013		37,443	32,596[2]		25,131		21,519	
Q	3.21	1.89	0.37	3.92	43,400*	42,300	40,780	38,150		29,300			
R	2.94	1.92	0.27	3.59			39,136	40,187[3]		29,617		24,937	
S	2.70	1.75	0.28	3.31	51,040		{42,910 {Ni-1.15			38,800		36,570	
Z	3.29	1.10	0.11	3.66			{36,250 {1.09d		{31,000 {1.50 d.	30,260	27,710	27,480	

*As Cast.
**Sulphur—0.12 and phosphorus—0.69.
***Phosphorus—0.54; Sulphur—0.170; Carbon—3.35, and Silicon—1.54.
E.C.—Effective carbon, or position relative to the eutectic.
[1]Nickel—0.41 per cent.
[2]Nickel—0.40 per cent.
[3]Nickel—0.51 per cent.

Fig. 1—Part of the Pouring Bay in Front of Open Hearth Furnaces in Steel Foundry of Skoda Works, Pilsen (Plzen)

Surveys Foundry Industry *in Czechoslovakia*

By Fr. Pishek

DISCOVERY by Dr. Wankel of two molds, one bronze and one stone in the prehistorical cavern called Bull's Rock near Brno, Moravia, also a bronze cast statue of a bull indicate that the foundry art was practiced in the remote past in Czechoslovakia. These molds, originating approximately from the fifth century before Christ, only served for casting bronze objects. At that time no other material, fit for casting, was known.

Cast iron, that is an alloy of iron with comparatively high carbon content was not known. In the original metallurgical furnaces, wrought iron, that is an alloy of iron with low carbon content in a pasty state was produced, which was further worked into the desired shape only by forging.

Gives Industrial Data

THIS interesting picture of the foundry industry in Czechoslovakia has been secured from an address delivered by Professor Dr. Mont. Fr. Pishek when he took the chair recently as director of the Technical High School at Brno, the principal city in that part of the Czechoslovakian republic known as Moravia.

In Bohemia the foundry industry became concentrated in the river basin of the Berounka in the Brdy-mountains, in the zone between Prague and Pilsen the old iron works Straseci, Zbiroh, Komarov, Karlova Hut, etc., came into existence. The Iron-Works Straseci are mentioned in history before the year 1325.

Two centers were developed in Moravia, the region along the rivers Svitava and Punkva, with the iron works in Adamov, Blansko, Jedovnice etc. and the Frydlant region in the Beskydy mountains. According to ancient records, these were worked before the year 1420.

In ancient Austrian-Silesia two centers of iron-industry arose. The most ancient, mentioned in the thirteenth century, is situated in the east part of Silesia in the Sudetic mountains: Cukmantl, Mala Moravka, Einsiedl, Benesov, Buchberg, Karlsbrunn

Table I

Raw Materials Used in the Foundry Industry

(Weight in Metric Tons and Value in Crowns)

Year		Pig Iron	Scrap	Coke
1927	(tons)	103,600	136,950	51,564
	(crowns)	98,800,000	75,000,000	15,000,000
1928	(tons)	135,700	204,752	64,562
	(crowns)	124,100,000	111,000,000	19,000,000
1929*	(tons)	72,000	.....	40,574
	(crowns)	53,000,000	.....	12,000,000

*First six months of 1929 only.

Table II

Typical Foundry Products

Year		Weight tons	Value crowns	Workmen	Wages crowns
1927		9000	22,950,000	.....	.....
1928	Radiators	12,600	32,400,000	670	8,750,000
1929*		5800	14,580,000	.....	.....
1927		27,000	15,120,000	.....	.....
1928	Bath Tubs	34,000	21,000,000	250	.....
1929*		17,000	10,550,000	.....	.....
1927	Hollow ware	5596	26,597,000	.....	.....
1928	and stoves	7031	33,062,000	700-800	.....
1929*		2038	8,927,000	.....	.....

*Statistics for 1929 only cover the first half of the year.

etc. The second, of later date, is in the West, in the vicinity of the Frydlant center, Baska, Karlova Hut.

In Slovakia the center of the iron industry was formed in the Slovakian ore-mountains, Roznava, Stitnik, Chyzna voda etc.

The continually rising demand for iron resulted in the building of higher furnaces, equipped with improved blowing apparatus. Increased temperature in the furnace occasionally resulted in a liquid instead of a pasty iron. This iron could not be forged. It was brittle on account of the high carbon content. Therefore it was of no use at that time, where forging was the only method known for working iron. Repeating cases of obtaining this liquid iron led to the invention of the puddling process, for removing carbon from the solid iron and thus converting it into wrought iron. In the beginning of the 15th century some melters discovered that this liquid iron could be poured into molds.

The first castings were cannons and cannon balls. These were followed soon after with the production of pots, kettles, stoves and other objects of daily use.

These castings were poured directly from blast furnaces 20 to 23 feet in height. The molten cast iron was drawn with hand-ladles from the forehearth and poured into molds.

The Swedish wars, and the Napoleonic wars, gave a great impetus to the foundry industry. After the war new cast iron products were introduced. In the beginning of the nineteenth century enameling of cast iron was introduced in the Brdy mountains and in Blansko. In 1813 the practice of pouring pipes vertically was started in Blansko. Development of the machine industry increased continuously the consumption of cast iron. Remelting of cast iron in cupola furnaces was introduced in the beginning of the nineteenth century. The first cupola furnace was erected and operated in the Blansko iron works in 1811.

The steadily increasing machine industry and the construction of railways caused extensive changes in the iron industry. Charcoal gave place to coke for the production of pig iron. The first coke blast furnace was put into action in Kladno in 1854.

Changing conditions, depletion of charcoal and ore sources, sharper competition halted the building of further stacks. The operators blew out one blast furnace after the other and gradually came to operate foundries alone or in connection with fabricating plants. Some of these plants were closed or were transported into cities, where better working conditions prevailed for the machine industry. A few still continue to function in their original ancient location. The last charcoal blast furnace in Frydlant, Moravia was blown out in 1900 and in Komarov near Horovice, Bohemia in 1922.

The small charcoal blast furnaces in the Slovakian ore mountains also have been blown out. Only four modern iron works remain. These are Witkowitz and Trinec, in the Moravian coal district Ostrava-Karvin, which supplies excellent coke,

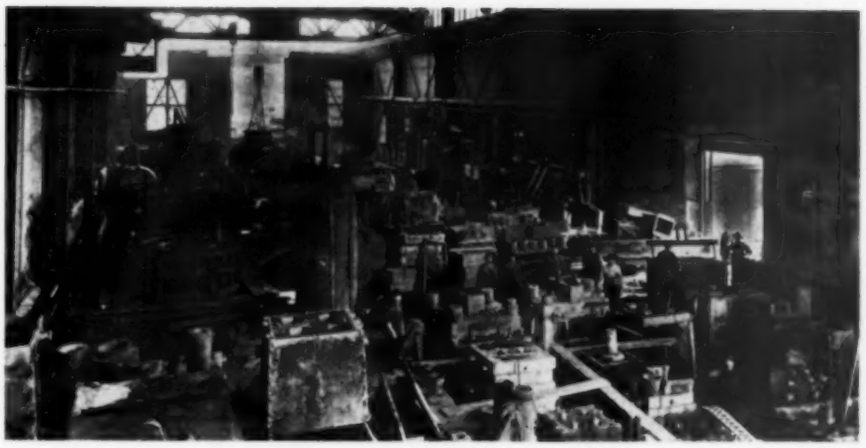


Fig. 3—Ingot Molds and Other Heavy Gray Iron Castings Are Made in this Foundry of the Tron Works, Witkovice

Table III

Gray Iron Foundry Operations

Year	Output Metric tons	Workmen	Wages Crowns	Value of Castings Crowns
1927	69,106	2600	30,000,000	160,000,000
1928	75,559	2800	31,000,000	179,000,000
1929*	45,068	3000	19,000,000	105,000,000

*Statistics for 1929 cover only the first half of the year.

Table VI

Malleable Iron Foundry Operations

Year	Output Metric tons	Workmen	Wages Crowns	Value of Castings Crowns
1927	3,968	750	4,650,000	30,150,000
1928	4,914	880	5,570,000	36,650,000
1929*	2,930	920	3,200,000	17,250,000

*Only for the first half of the year.

Fig. 2—Main Bay in Iron Foundry with the Coremaking Departments to the Right in the Skoda Works

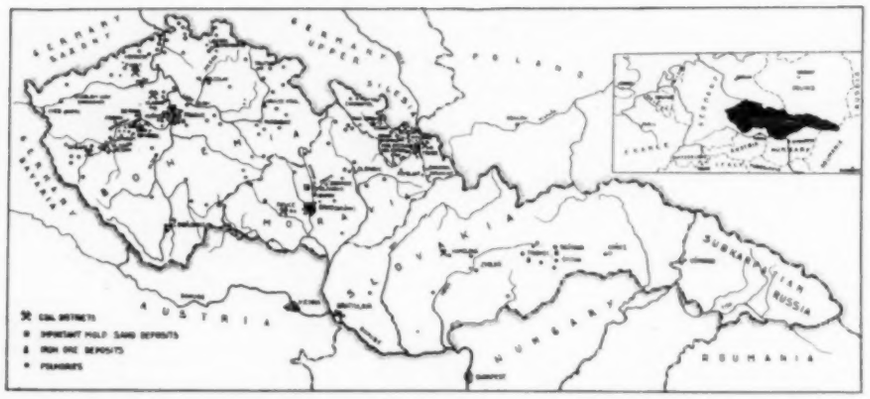


Fig. 4—Map of Czechoslovakia Showing Location of Coal Districts, Molding Sand Deposits, Iron Ore Deposits and Foundries

yet is lacking ores in the vicinity, and Konigshof and Kladno situated near the large Nucice ore-district, where, however, coke has to be transported from the Ostrava coal field.

In consequence of this development three types of foundries for gray iron came into existence: Commercial foundries, foundries annexed to the machine factories and working only for their own machine factory, foundries working for their own machine factory and for others.

Older foundries are in their original location, but location for new foundries has been dictated either by proximity to markets or to raw materials.

In Bohemia these main centers of the foundry industry are in Prague and surroundings with a large machine industry; in western Bohemia especially the Berounka valley from Beroun to Pilsen and in north Bohemia near the important industry and brown-coal fields. In the Moravian-Silesian country, foundries are located in Brno and surroundings with a large machine industry and considerable molding sand deposits. The Moravska Ostrava region is a most important center of Cechoslovakia coalfields with a large machine industry. Smaller foundries are distributed throughout the Slovakian ore mountains.

Location of some centers of the foundry-industry in regard to raw material and to the outlet is unfavorable, particularly the west Bohemian center where raw materials, coke and pig iron must be imported from the Ostrava region, and finished products have to be retransported into the center of the state.

This location became unfavorable only after the destruction of Austria and the creation of Czechoslovakia. In the ancient monarchy this region was situated between its most industrial cities, Prague and Vienna. Transport of finished products constituted a continuation of the direction of the raw material transport.

The Brno center lying nearer to the center of the republic is more favorable for the foundry industry, yet not so much as before the war, when it was on the way between Moravska, Ostrava, and Vienna.

Are Far from Supplies

Foundries in Slovakia, chiefly in the ore mountains region are worst located of any. They are situated on the edge of the state, where there is not any great industry and far from Moravska, Ostrava, the main supplier of raw material. Today throughout Slovakia there are only 17 foundries, of which two are commercial.

The number of the gray iron foundries, in Czechoslovakia, according to the report of the Czechoslovak Metal working Industry association is only 170 employing 16,000 workers. If all the small foundries are included, the number probably is about 300.

An idea of the Czechoslovak foundry industry, may be gained from some figures covering consumption of raw materials and production of castings shown in accompanying tables.

Some statistics of six of the largest gray iron foundries: Mining & Smelting Co. Brno-Kralovopole Machine & Wagon factory; Ceskomoravska-Kolben-Danek in Prague First Machine Factory Association in Brno; Skoda Works Joint Stock Co. and Witkowitzer Mining and Smelting Union are shown in Table III.

Totals for all gray iron foundries may be estimated approximately, according to the total consumption of pig iron, scrap and foundry coke, for the year 1928 as: 220,000 tons of castings, 16,000 workmen who earned 145,000,000 crowns in wages and produced castings valued at approximately 700,000,000 crowns.

At the present rate of exchange the crown is quoted at 0.296, or approximately 3 cents.

Approximately 20 per cent of the castings produced in Czechoslovakia are expected, principally to Austria, the Balkan States and in a small degree to Hungary and Poland.

Export of machinery made up in part or in whole of castings amounts to approximately 40 per cent of the total production.

Gray iron castings produce in Cechoslovakia range in weight from the smallest up to 80 tons. The cupola is in universal use. Only two plants operate air air furnaces or electric furnaces.

Ten mallaeble iron foundries are in operation, employing about 1000 men. Most of these foundries were founded in the nineties and melt iron mainly in cupola furnaces. Reverberatory furnaces are employed for melting the metal in two plants.

The most important malleable cast iron foundries include the Joint-Stock foundries in Komarov near Horovice; Ceskomoravska-Kolben-Danek in Prague; Moravian Iron and Steel works in Olomouc; Ignac Storek in Brno and Bratri Uxove in Brno. Production and other features in connection with these foundries are shown in Table IV. Total production of all malleable iron foundries may be estimated for the year 1928 as 5200 tons, the number of workers approximately as 950, the wages earned about 6,100,000 crowns and the value of castings 37,600,000 crowns. Approximately 35 per cent of the total is exported chiefly to

Table V

Steel Foundry Operations

Year	Output Metric tons	Workmen	Wages Crowns	Value of Castings Crowns
1927	24,520	900	19,500,000	147,000,000
1928	28,480	2,150	21,000,000	171,000,000
1929*	16,160	2,400	12,000,000	97,000,000

*For the first six months only.

Table IV

Brass and Bronze Foundry Operations

Year	Output Metric tons	Workmen	Wages Crowns	Value of Castings Crowns
1927	1,170	160	2,000,000	19,000,000
1928	1,360	200	2,300,000	22,000,000
1929*	724	230	1,100,000	12,300,000

*For the first six months only.

Austria, Poland, Italy and Yugoslavia.

Eight steel foundries employing 2300 men are operating in Czechoslovakia. Steel is produced chiefly in open-hearth furnaces. In a few plants electric furnaces are in use. One small converter is used in one works. Operation of the steel foundries, that is of the Ceskomoravska-Kolben-Danek in Prague, Moravian Iron and Steel-Works in Olomonc, Ignac Storek in Brno, Skoda-Works and the Witkowitzer Mining and Smelting Union are summarized in Table V. Approximately 50 per cent of the production is exported. In Czechoslovakia steel castings are made up to a weight of 100 tons.

Total production of all the steel foundries during the year 1928 amounted to approximately 30,000 tons. The number of workers may be set down as 2400 who earned 23,000,000 crowns. Value of the produced castings was approximately 180,000,000 crowns.

Approximately 70 brass and bronze foundries are in operation. These foundries with some exceptions are all small, either annexed to a manufacturing plant or independent. Status of the three largest works, Mining & Smelting Co., Ceskomoravska-Kolben-Danek and the Skoda Works is shown in Table VI. The total production of all of the bronze and brass foundries is not available. Some of them only employ apprentices.

Most of the aluminum is cast in brass foundries. There are two independent aluminum foundries, the Ceskomoravska - Kolben - Danek in Prague and the Skoda Works in Pilsen. Statistics on these plants are given in Table VII.

Annual production of all castings in the Czechoslovak republic amounts to more than 250,000 tons, with a total value of over one milliard crowns. Wages amounted to approximately 180,000,000 crowns.

Up to the outbreak of the world war foundries were neglected. Only a few were equipped in a modern way. After the war, foundries were unprepared for the decreased inland sale. They were faced with the problem of finding opportunity of sale abroad. The deflation period of 1922 exerted a serious influence on our foundry industry. After the inflation turn of the market, sales stopped at once. Stocks of raw materials were reduced in value. Many well managed old foundries got into a critical situation during this time. The situation began to improve in 1923. Many foundrymen realized the necessity of modernizing the foundries so that they could compete with the foundries abroad.

Today, many works are equipped with laboratories and effort is made to improve the quality of the castings. Foundrymen are installing transportation systems, and efficient molding machines. They are studying fuels for melting and drying furnaces. Care is bestowed on the selection and preparation of molding sand.

No castings are made on a continuous production basis. Even in the automobile industry, the production in any factory does not justify continuous production.

The future of the foundry-industry depends on specialization and on the adoption and installation of the best technical equipment. Specialization already has been attempted in some instances. Eventually it is hoped that all foundries will be as well equipped, standardized and capable of operating as efficiently as the pipe shops.

Table VII

Aluminum Foundry Operations

Year	Output metric tons	Workmen	Wages Crowns	Value of Castings Crowns
1927...	700	160	2,280,000	22,400,000
1928...	900	200	2,965,000	27,900,000
1929*..	390	160	1,960,000	12,000,000

*For the first six months only.

AluminumHasImportant Part in Building

(*Concluded from Page* 93)

Method of pouring the metal into the mold is shown in Fig. 5 where four men pour the contents of two crucibles simultaneously. The device enclosing the side of the flask and provided with handles, is a shield designed to protect the men's feet in the event that any metal might leak through the joint of the flask. It may be attached and detached readily and it is placed on each flask in rotation as they reach the pouring station. Depending on the size of the casting, two or four thin, flat, riser openings are provided on top of vertical ribs which extend from side to side of the casting. When the metal appears in these risers, the men cease pouring.

In its spacious and well equipped foundry in Cleveland, the United States Aluminum Co., makes a wide variety of castings ranging in weight between a few ounces and 2 tons. A total of 5400 pounds of metal was required to pour a diesel engine 6 cylinder and crankcase block recently. This casting was approximately 5 feet in height and 10 feet in length. The outside was formed in green sand in a wood flask. The interior was formed in an intricate set of dry sand cores.

Gray Iron Has Valuable Engineering Properties

(*Concluded from Page* 97)

seem to militate against it for routine testing and there is a question** whether results obtained from so small portions of a relatively large casting are as indicative of the quality of either the iron or the casting as are separately cast test bars made from the same metal as the casting." (Particularly if these are chosen to approximate the cooling rate of the important casting section.) "Unless the small shear specimens are selected intelligently from the casting they may be misleading; in fact, in matters of specification and contract it would seem that the location to be drilled for samples would have to be definitely stated."

W. Rother asks, "Are the results obtained from such small test pieces as reliable as those obtained from one of much larger cross section? We do not believe they are."

W. Jolley writes, "It appears that high shear test values can be obtained with irons that give low transverse and deflection test.—It would seem also that a premium is placed on poor material by the shear test.—Much has been made of the fact that small test pieces can be cut from the casting itself for testing. No one will deny the advantage of this, providing the results obtained are true and that the piece taken represents the bulk of the casting. Besides the troubles already dealt with — ratio and composition — it often happens that the portions most liable to weakness can not be drilled owing either to their position or the effect of replugging the hole on the wearing part of the casting. The question as to where the casting should be drilled would in many cases be a constant source of trouble between the firm and the visiting inspector. The writer acting as an inspection engineer, would never dare to pass on physical strengths from the results obtained alone from the shear test."

In addition to the opinions given, attention is called to the fact that the shear test does not give a direct indication of the tensile strength of the metal. Hence, the figure may prove deceiving to the designing engineer, who does understand the tensile test.

With proper care shear tests can be made accurate and results can be checked. Within certain limits there is a direct relationship between shear and tensile. However, this relationship does not apply in some types of commercial irons and the shear test may be misleading. It is an excellent research tool for probing the uniformity of castings and may be useful for approximating the strength of castings too small to be sectioned for tensile test.

HEAT TREATMENT *Determines* Properties of Manganese Steel

By Harry P. Evans

TWO major types of manganese steel are used for casting purposes. The first is the Hadfield or high manganese steel of the austenitic type containing 10 to 14 per cent manganese and 1.00 to 1.4 per cent carbon and the second, is the low manganese steel of the pearlitic type containing 1.00 to 2.00 per cent manganese and 0.25 to 0.50 per cent carbon. In addition to the two types previously mentioned, silicomanganese and one or two other special manganese steels are utilized in castings.

Hadfield or 12 per cent manganese steel responds to heat treatment in an opposite manner to most steels. Steels generally become hard by quenching and subsequently become softer and tougher by drawing at points below the critical temperature. Manganese steel is tough and comparatively soft after quenching *dead cold* in water. It is used in industry after being given that treatment. A subsequent draw back at ordinary tempering temperatures makes it hard, brittle and of little use for industrial purposes.

Explains Mechanism

Any steel when heated above its critical temperature passes into the nonmagnetic, gamma iron, austenitic state. Most alloying elements, including carbon up to 1.7 per cent are soluble in gamma iron. Unless an obstructive element is present in solution, it is impossible to hold iron in the gamma condition and the carbon in solution even by the most severe quenching. If an ordinary carbon tool steel is quenched quickly sufficient time is given for a part of the iron to change from the gamma to the alpha state and for some of the carbon to be precipitated in an extremely fine condition. The result is hard martensitic steel. As the cooling rate is reduced, time is given for more and more of the nonmagnetic, austenite to change to alpha iron and for the carbon to precipitate as iron carbide. These progressive cooling rates leave the steel in the troostitic, sorbitic and finally the pearlitic state, on slow cooling. Softer structure than martensitic also may be obtained by quenching severely and then drawing or tempering at the proper temperature.

If a steel containing 10 to 14 per cent manganese and 1 to 1.4 per cent carbon is heated to approximately 1900 degrees Fahr., it passes into the same nonmagnetic austenitic structure that is obtained with a tool steel. However, the large amount of manganese acts as an obstructive element towards the gamma to alpha change and the precipitation of carbon or iron carbide. The whole mass may be obtained as austenite at room temperature by rapid quenching, but the steel is in a metastable condition. If heated or given a draw back, the brake is released and the carbon precipitates as hard, brittle, iron or manganese carbide, the amount depending on the temperature at which the steel is tempered. For that reason 12 to 14 per cent, manganese steel does not retain its toughness at elevated temperatures. Many sound and properly treated manganese steel castings have been made brittle and unsatisfactory by heating, say for forging, bending or even for welding unless that operation is performed intelligently and carefully.

Steel Is Unstable

Quenched, strong, tough, austenitic manganese steel is so unstable that even cold work or impact will permit the gamma-alpha transformation and precipitation of carbon. Manganese steel owes its great value to industry, largely to this unique property. When manganese steel is placed in service and receives considerable impact or pounding, the surface goes through much the same change as severely quenched carbon tool steel. It changes, partially at least, to the extremely hard martensitic state. The surface brinell may be raised from 200 brinell or slightly less to possibly 400 brinell. That surface naturally resists abrasion effectively, but it is backed still by the tough austenitic structure. As this hard surface gradually wears away, the subsequent impacts prepare more of this hard surface material and the process continues throughout the life of the casting. It is in that type of service, abrasion with severe impact, that Hadfield manganese steel should outwear any other commercial steel casting. Where abrasion exists without impact other heat treated alloy steels of the pearlitic type such as chrome-nickel, chrome-molybdenum, and others may equal and even excel manganese steel in service.

However, even in the latter type of service and in service requiring extreme strength and particularly toughness, manganese steel may be used. When a steel of the pearlitic class is treated to resist abrasion and develop its maximum ultimate

Explains Methods

WHILE the uses and heat treatment of manganese steel castings are fairly well understood, the author in this article, which is an abstract of a discussion on the heat treatment of manganese steel castings presented at one of the steel foundry shop operation courses conducted at the recent convention of the American Foundrymen's association in Cleveland, explains the mechanism of the changes which confer special properties on that type steel. That class of casting finds its greatest field where there is a combination of abrasive and impact action. There are other uses but special alloy steels often give superior service. Low manganese steel, if properly treated, will give physical properties comparable to more complex alloy steels. Such properties are not well known to engineers. The author is metallurgist, Continental Roll & Steel Foundry Co., East Chicago, Ind.

strength, it must be quite hard and may be somewhat brittle while manganese steel can be put under the press and straightened without undue fear of breakage. For that reason, manganese steel may be used in fairly heavy and intricate sections when the use of a quenched steel of the pearlitic type is questionable.

The second or pearlitic type of manganese steel contains from 1.0 to 2.0 per cent manganese and 0.25 to 0.50 per cent carbon. While that steel does not develop quite as satisfactory physical properties as more heavily alloyed and more expensive steels of the chrome-nickel and chrome-molybdenum type, at higher brinell values, it has much better properties than many engineers realize. In the normalized and drawn, or quenched and drawn condition, a 0.30 to 0.35 per cent carbon, 1.40-1.50 per cent manganese steel at 200-220 brinell will show an ultimate strength almost the equal of, and a ductility slightly higher than, a .30-.35 per cent carbon, 1.50 per cent nickel and 0.75 per cent chromium steel at the same brinell value. At considerably higher brinell values, its toughness falls off somewhat more rapidly than some of the more heavily alloyed steels. Low manganese steel is susceptible to heat treatment and, particularly when used at a brinell not over 250, makes remarkable castings. For light castings, and also heavier castings where the section is uniform, that steel gives excellent results by merely normalizing with no draw back.

Describes Heat Treatment

Heat treatment of low manganese steel is similar to that of others of the pearlitic type. Although manganese lowers the critical temperature somewhat over a straight carbon steel of the same carbon content, the manganese absorption above the critical is slow, so that the annealing or normalizing temperature should not be lowered because of the high manganese content. Because of the lowering of the critical points, particularly the Ar_1 point, that steel will harden when quenched at relatively low temperatures. That property is of particular value when time is lost between the furnace and the quench. Low manganese steel should be normalized or annealed from a temperature of approximately 1650 degrees Fahr. If the section is heavy and the casting is to be given a second heating, the first treatment may be carried somewhat above 1650 degrees Fahr. to break up the as cast structure and completely homogenize the material. Since the first treatment destroys the as cast structure any second treatment may be carried out at a lower temperature, around 1575 degrees Fahr. to give a minimum grain-sized structure. If the casting is quenched, the drawback, which should not be hurried, will depend upon service required.

Ohio Group Meets at Cincinnati

A STUDY of the characteristics of synthetic molding sand and a discussion of numerous problems facing the various branches of the foundry industry featured the third quarterly sectional conference of the Ohio Foundries association which was held at the Sinton hotel, Cincinnati, August 15. Approximately 100 members of the association and guests attended the luncheon meeting and took part in the group discussions.

Must Select Materials Carefully

Following the luncheon Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O., president of the Ohio Foundries association, called the meeting to order and introduced M. J. Dunbeck, Eastern Clay Products, Inc., Buffalo, N. Y., who spoke on the use of clay bonds in molding sands. Mr. Dunbeck pointed out that Dr. Moldenke in 1915 mentioned the possibility of using round grains of sand of a uniform size coated with a high bonding clay, as a molding sand. He then explained briefly the various investigations that were conducted during the following ten years and stated that the first clay bond was placed on the market in 1924. Clay as a bonding medium may be added in the facing, to the heaps in dry form, as a mixture of clay and water spread over the heap or to the top of the mold as it travels to the shakeout. Adding the clay bond to the heap in the dry form is the most difficult method due to the care necessary in mixing the clay thoroughly with the sand grains. However, when the clay bond is mixed with water to form a creamy slurry and is spread over the heap, the bond seems to develop the fullest efficiency.

It was pointed out that several important factors must be given due consideration in the selection of materials used in the production of a synthetic sand. It is necessary to secure a base sand having the proper grain size and refractory qualities. Often in production shops the sharp sand is used first in cores, later being reclaimed and used as a base in the molding sand. It also is necessary to select the type of bonding clay particularly adapted to the needs of the plant. It is important to have high strength to reduce the amount of bonding material necessary. Other considerations are high refractoriness, high vitrification point, long life and wide moisture range. Mr. Dunbeck also presented information on the results that had been obtained in the use of synthetic molding sands.

John L. Richey, Cincinnati Association of Credit Men, Cincinnati, spoke briefly of the work that is being done by various groups of industries in the Cincinnati district with reference to credit problems. He also mentioned the possibility of developing such a group for the foundry industry in the district.

Hold Group Conferences

Four group conferences were held immediately following the formal addresses in which problems relating to the gray iron, steel, nonferrous and patternmaking branches of the industry were discussed. Ray Redman, Buckeye Foundry Co., Cincinnati, was chairman of the gray iron group, E. A. Leary, Cincinnati Steel Castings Co., Cincinnati, presided over the steel meeting, Edwin H. Hausfeld, Ohio Pattern Works & Foundry Co., was in charge of the patternmaking group and Harley Nash, Ohio Pattern Works & Foundry Co., was chairman of the nonferrous session.

Internal shrinkage and segregation furnished a topic for considerable discussion in the gray iron group. It was pointed out that these difficulties might be eliminated through variation in temperature, use of chills, change in the composition of a metal and the use of risers. The production of semi-steel was discussed and it was pointed out that the amount of steel being used in cupola charges is increasing constantly. Cost methods were discussed.

Discuss Melting Practice

The steel foundry group discussed melting practice, the relative costs of the arc and induction type electric furnaces, and the condition of business in the various plants represented. The pattern makers discussed ways and means of preventing the manufacture of patterns unfitted for use in the foundry. It developed that many patterns are bought with price the only consideration and that no real effort often is made to secure a pattern that will produce castings in the most economical manner. The group expressed its willingness to cooperate with the association in solving some of these problems. The Ohio Foundries association has appointed a committee to work in conjunction with the pattern makers along the lines suggested by the group.

Walter H. Geier, Cincinnati Milling Machine Co., was general chairman and Phil H. Cone, Cincinnati Milling Machine Co., was assistant chairman of the committee arranging the conference. The next sectional conference will be held in conjunction with the annual meeting in October.

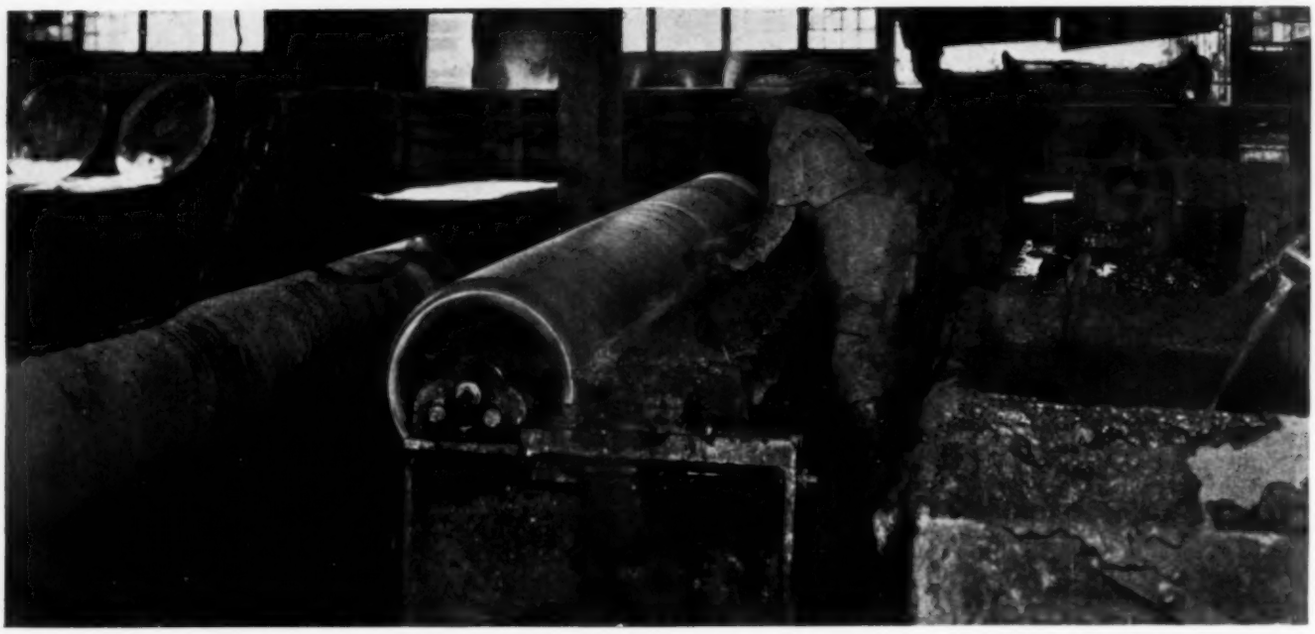


Fig. 1—Operators Develop a High Degree of Speed and Skill in Applying a Loam Coating To the Revolving Barrels

Casts Pipe Vertically in Sand

In Its Green State the Sand in the Molds Shows a Moisture Content of 12 Per Cent and a Permeability Number of 400

By Pat Dwyer

GENERAL layout of the plant of the National Cast Iron Pipe Co., Birmingham, Ala., with its manufacturing buildings, yards, streets and houses of many of the employes is shown in Fig. 3. A colored picture would be required to do justice to the smooth emerald lawns, the ornamental shrubs and gorgeous semitropical flowers which present such an inviting approach to the office, located approximately at the center near the right boundary in Fig. 3. The office and all the other plant buildings are of substantial brick construction and present a spick and span appearance in marked contrast to the popular conception of a casting plant. The same spirit of ordered neatness is in evidence on the inside of the various buildings and on the driveways and yards on the outside.

The entire assemblage serves as a refutation to a fairly common impression that all iron and steel plants are dirty, disorderly places covered with grime and soot and that a foundry is the dirtiest, most disorderly, grimiest and sootiest member of the group; the tail end of the entire industrial procession.

The impression, like practically all generalities, is based on a certain substratum of truth. In the so-called good old days, the dirty and disorderly foundry was the rule rather than the exception. Foundries erected and operated in recent years reflect a new managerial attitude. A man is known by the cut of his clothes and a plant is judged frequently by its outward appearance. A modern foundry is equipped with elaborate and expensive mechanical devices and the castings—in many instances—must conform to close and rigid specifications.

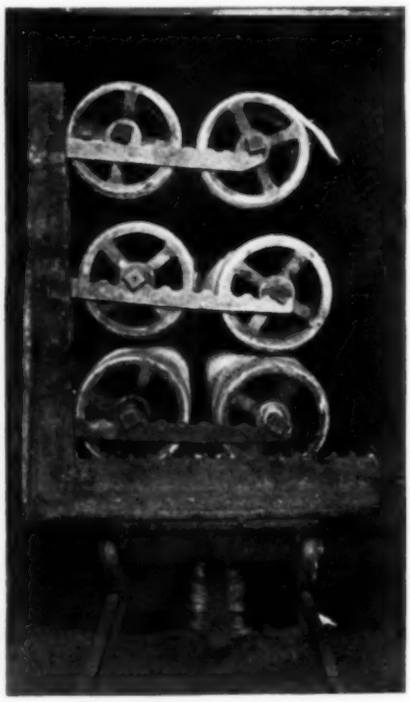


Fig. 2—Specially Designed Racks Support the Cores in the Oven

To quote a prominent foundry engineer: "When men spend a million dollars or several millions building and rigging a foundry, they want it to look like something else besides a pig pen."

E. E. Linthicum, president of the National Cast Iron Pipe Co., has been connected with the cast iron pipe industry since boyhood, first in Chattanooga, Tenn., then in Anniston, Ala., and later in Birmingham where he resigned from the American Cast Iron Pipe Co., in 1913 to organize the National Cast Iron Pipe Co., and build the present plant. Experience gained over a period of many years is reflected in the physical features and general appearance of a plant which harmonizes with its surroundings in this bustling and beautiful southern city. The original property of 50 acres later was augmented by the addition of 41 acres to form a residential section for many of the employes.

Methods and equipment in the centrifugal department of the plant where pipe castings are made according to the deLavaud process un-

der license from the United States Pipe & Foundry Co., were described in the August 1 issue of THE FOUNDRY. The present description is confined to the pit shop where pipe from 3 to 36 inches diameter is cast vertically in dry sand molds, and the miscellaneous fittings shop where pipe fittings in almost endless variety of sizes and shapes are made in green sand, skin dried and dry sand molds.

The pit shop 480 feet in length is divided by a central row of columns into two longitudinal bays, one 40 and the other 60 feet in width. The wider bay contains four long, narrow, rectangular pits in the floor, one for the production of pipe 4 to 12 inches in diameter, in 16-foot lengths, the other three for pipes 3 to 36 inches diameter and in the standard 12-foot lengths. The daily capacity of this shop is given as 250 tons.

Make Mold in Pit

Molds for the pipes are rammed, dried, assembled and poured directly in the pits. The only occasion on which the mold leaves the pit is when the crane lifts mold and casting and dumps them on the floor at a point close to the wall of the building and midway between two of the pits. The pit bay of the foundry is served by four traveling cranes ranging in capacity from 5 to 15 tons. Jolt machines in this foundry have taken the place of the long pneumatic rammers, suspended from pulleys and counterweighted, widely used in pipe foundries. Each pit is laid out in the shape of a capital *L*, with the base serving as a ramming and blacking station and the long, straight section devoted to drying and casting stations of the foundry.

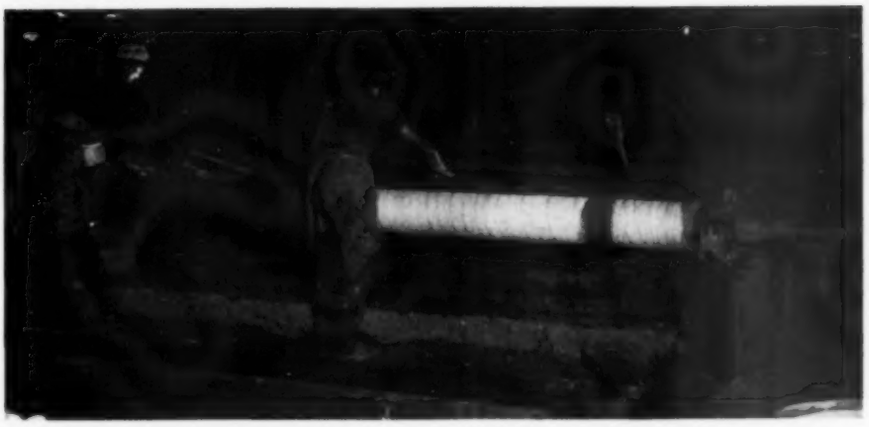


Fig. 4—A Special Cardboard Strip Takes the Place of the Old Time Hay Rope on the Barrel

In the cycle of operation, the closed flask is lowered vertically onto the table of the ramming machine where it is centered in relation to the pattern. The construction of the pattern varies to some extent, depending on the size. Pipe from 3 to 12 inches in diameter are molded and cast with the socket end up. Larger pipe, in this instance all sizes between 14 and 36 inches, are molded and cast with the socket on the lower end. Two jolt machines in each pit facilitate production. Thus while one machine is jolting one mold, the operators remove the mold from the other machine, black it and place it on the drying stool. A second empty flask is lowered into place and the operation is repeated on the first machine. Sand is shoveled into the flasks by hand, but since the average thickness of sand between the pattern and the flask is only 1 inch, the amount shoveled into any given flask is not great in this operation.

The newly blacked mold is placed over one of a long row of openings in a shelf located near the bottom of the pit. A gas jet burning in the opening dries the mold in from 3 to 6 hours, depending on the size of the flask. A constant succession of molds is made during the day and placed over the drying stations. A night shift places the cores in the dried molds and commences pouring iron about 11 p.m.

From that time until morning, pouring and shaking out go on simultaneously. Immediately after the metal has set in the mold, the crane is attached to the core barrel. The barrel is extracted and placed to cool in a convenient position for the coremaker on the following day. Then the flask is lifted out of the pit and conveyed to the nearest shakeout station where it is lowered in a horizontal position and the clamps are removed from along one side. The other side of the flask is hinged. The flask may be opened to discharge the casting, but the two halves of the flask never actually are taken apart.

Skill Is Shown

Operators on the cranes develop a high degree of speed and skill. They juggle the large, heavy, cumbersome flasks with the ease and deftness which distinguish the professional in any line from the amateur. The hot pipe rolls on a pair of rails out through an opening in the wall of the building. The sand falls in a pile on the floor and the flask is re-clamped and stacked near the ramming station.

Sand employed for pipe molding bears little resemblance to molding sand as the term usually is understood. It is practically a gravel with angular rather than rounded grains and carries scarcely any natural bond. This explains the rather startling information that according to the specifications of the American Foundrymen's association, the sand shows a permeability number of 400 and is worked while the moisture content is 12 per cent. The neces-

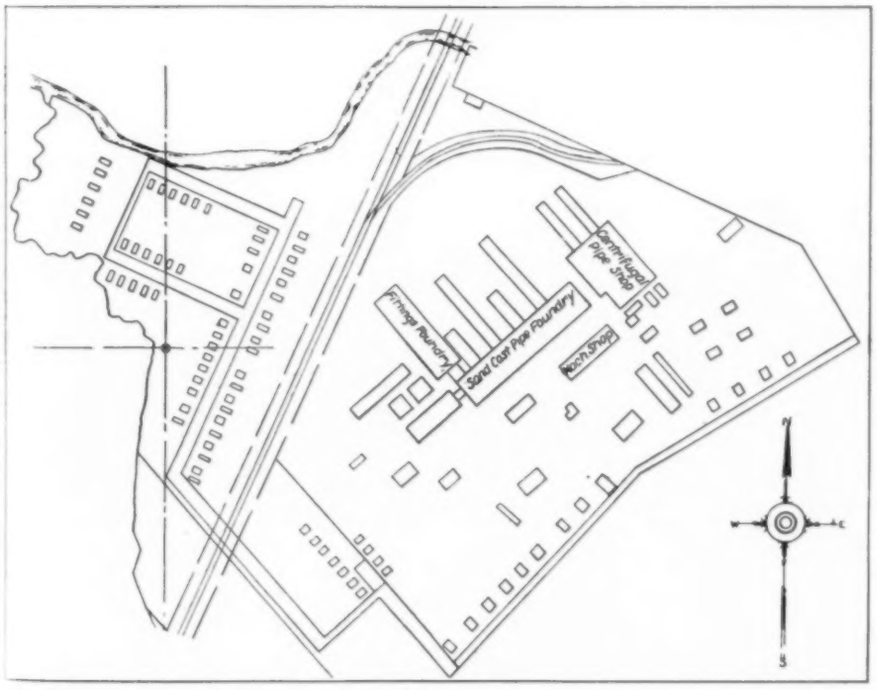


Fig. 3—The Present Group of Buildings Occupies Only a Small Part of the Property

Fig. 5—Green Sand Molds and Cores Are Made in Special Shaped Iron Flasks for Various Pipe Connections

sary amount of bond is imparted by wetting the shaken out sand with claywash. Through experience, a rule has been worked out whereby a definite amount of claywash, measured by the bucket, is thrown over the sand from each size of flask. At periodic intervals a grab bucket suspended from the crane is employed to carry the sand from the shakeout station to the molding station. On account of the extreme permeability, the moisture penetrates the sand easily and rapidly. At the molding station the sand is shoveled through an upright screen before it is shoveled into the flasks. A little new sand is added occasionally to compensate for the small amount lost in the shakeout process.

Use Cast Iron Barrels

Except in the small pipes where steel tubes serve as core barrels, heavy, substantial cast iron core barrels are employed. The barrel terminates at each end in an internal cross which supports a steel spindle. One spindle is plain and short, while the other is extended and changed from a cylindrical to a square shape. The square end fits in the end of a socket bar attached to the motor which revolves the barrel while the attendants are applying the coating of corrugated paper, loam and blacking. This connecting socket bar is detachable.

Spindles at each end of the core barrel rest in roller bearings supported on cast iron frames. A screw adjustment in the frame serves to regulate the distance between the barrel and the long sweep or striking board and the consequent thickness of loam applied to the barrel. These features are illustrated in Fig. 1. The socket end of the large pipe core is made in a corebox and is provided with a suitable seat to receive the machined end of the main core barrel and the tapered loam thickness. In assembling the mold, the socket core first is placed in position. Then the long flask is lowered and afterward the long barrel core is lowered into place. The joint between the cores is sufficiently accurate to seal the opening and prevent any metal from leaking through. The core is lifted into the mold and the barrel is extracted later by a clevis attached through a hole in the square end of the spindle.

Corrugated pasteboard in a continuous narrow strip has taken the place of hay rope as a preliminary covering for the core barrel. It is attached in a spiral while the barrel is revolving. The prepared loam is shoveled from a box on to the strike board and is pressed against the barrel by the hands of the operators. The loam is made up of a mixture containing 16 parts old core sand, 4 parts new sand and 4 parts clay prepared under a pair of rollers in a stationary cast iron pan, designed and built by the company. Two of these pans are in constant operation and the material is distributed to the various coremaking stations in a box suspended from a monorail.

The socket cores and cover cores are made from a somewhat similar mixture in which the four parts of clay have been replaced by one part of a proprietary liquid binder. This sand is mixed comparatively dry in a muller type mixer supplied by the Blystone Co., Cambridge Springs, Pa.

A row of core ovens extends almost the entire distance along one side of the core making bay. General features of these ovens, doors, carriage, racks, tracks and firing arrangement by gas from a perforated steel pipe laid on the floor, are shown in Fig. 2. A number of air hoists suspended from a monorail are available for handling the empty barrels, for loading the cores on the core oven cars and for unloading the cars again after the cores are dried. The cores are placed twice in the oven. First to dry the rough coat of loam and afterward to dry the slip coat and the blacking.

Poetry of motion is exemplified by the fast and clever workers who make these cores. The same instinctive sense of rhythm that caused their remote, barbaric ancestors in Senegambia, along the Congo river and on the Gold Coast, to bend and sway and jump to the throbbing beat of the jungle drum, impels these men to time their every movement to the same swinging tempo.

Work Has Rhythm

The core barrel for a 12-inch pipe is hooked to the crane, pushed in the direction of the coremaking station, dropped into place and started revolving in a series of movements as regular and as graceful as the swing of a pendulum inside the case of a venerable grandfather's clock. The cardboard strip is applied to the whirling barrel to an imaginary drum beat and is snapped off sharply at the end. Loam is piled on the board and distributed by hand—one—two—three—four, o n e—two—three—four—against the covered face of the barrel.

One movement releases the driver.

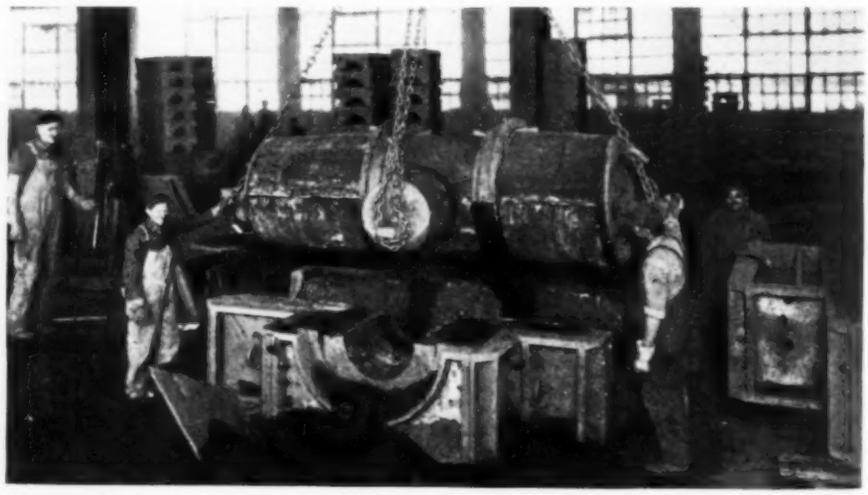


Fig. 6—Mold and Core Are Built Up Simultaneously for a Large Special Fitting with a Minimum Amount of Pattern Equipment

Another hooks the chain to the ends and another hoist and a push, lands the core on the oven car. The chains are attached to a second arbor for a 12-inch pipe—and the elapsed time is exactly one minute by any reliable stop watch, or, perhaps more accurately, 30 bars of 4-4 time beat out on an imaginary booming, big bass drum!

Iron is melted in a 66 and a 72-inch cupola with spouts converging to a common point where the ladles are filled. The ladle is mounted on a truck and is pushed by hand on a track laid longitudinally in the center of the building. In this manner the cranes are free to perform their other duties except while actually pouring the metal.

On account of the low manganese content of southern pig iron, a sufficient amount of granulated ferromanganese is added to each ladle of iron to raise the manganese content to approximately 0.50 per cent.

Standard and special pipe fittings in an almost infinite variety of sizes and shapes, are made in a foundry 100 x 200 feet, located a short distance from the pit shop and extending at a right angle to that building as may be noted in Fig. 3. The building is laid off into two main bays with two cranes in each. One bay is devoted principally to the smaller sizes of standard fittings where the patterns are mounted on several types of molding machines made by the International Molding Machine Co., Chicago and the Herman Pneumatic Machine Co., Pittsburgh. Green sand cores, with a cast iron arbor in the bottom of each, are placed in these molds. Typical floors are shown in Fig. 5.

The sand is not as coarse as that used in the pit shop for the dry sand molds, but it is coarser and much lower in bond than the sand employed in the ordinary jobbing gray iron foundry. As a result, scabs and cuts are unknown and no risers are placed on the castings.

The second bay is devoted principally to the production of large fittings, standard and special. Where only one casting is required, the mold is made with a minimum of pattern equipment as may be noted in Fig. 6 where the entire equipment included a pair of flanges, a templet and a few strikes. The drag is molded first, then the core is built right in place and the cope is rammed over the core. The cope is removed and finished. The core is lifted out and also finished. It is supported on a substantial cast iron arbor, with half circle wings wedged in place and with whole circle plates fastened at the ends. The drag then is finished and the mold is reassembled.

Fig. 7—(Left)—A Tilting Spout Diverts the Metal Either To the Right or Left. Fig. 8—(Right)—A low Truck Carries the Ladle from the Cupola To Any Desired Point Along the Pit Wall

This is the sixth of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early future issues of THE FOUNDRY. THE EDITORS.

Barrett-Cravens Co., manufacturers of lift trucks, platforms and portable elevators, has moved into its new plant at 101 West Eighty-seventh street, Chicago. Present line is continued.

Sublets Casting Jobs

American Locomotive Co., previously noted as having been awarded a contract for supplying 21, seventy-two-inch, bronze, riser valves and nine, 48-inch, bronze riser valves for the local board of water supply, has sublet the casting work.

The bronze castings will be produced by the William H. Cramp & Sons Ship & Engine Building Co., Beach and Ball streets, Philadelphia; American Manganese Bronze Co., Holmesburg, Philadelphia; Pennsylvania Bronze & Brass Co., Twenty-second and Master streets, Philadelphia; and William H. Barr Inc., 27 Caroline street, Buffalo. There are 526 tons of castings and forgings.

The 164 tons of steel castings involved will be produced by the General Steel Castings Co., Eddystone, Pa.

Form Farm Tools, Inc.

Five companies in Ohio, Indiana and Illinois have been merged into a $4,000,000 farm equipment corporation to be known as Farm Tools Inc. Firms included in the new corporation are the Roderick Lean Mfg. Co., Mansfield, O.; Roderick Lean Mfg. Co. of Indiana, Evansville; Hayes Pump & Planter Co., Galva, Ill.; Peoria Drill & Seeder Co., Peoria, Ill.; and Vulcan Plow Co., Evansville, Ind.

Pennsylvania Foundry Supply Co., has moved the location of its New England warehouse and office from 423 East Eight street, to 310 Congress street, Boston.

Preventing Unsoundness *in* Bronzes and Red Brass

Part II

IT IS possible and practical in melting brass and bronze to conduct the whole operation with neutral combustion products. This is done by some firms. However, the more usual practice is to start on the reducing and finish on the oxidizing side. This has been described in an excellent fashion by Darby in *Technical Publication* 302-1930, American Institute of Mining and Metallurgical Engineers, as follows:

"Of the three conditions of atmosphere mentioned, the most difficult to obtain in practice is the neutral one. Since it represents an absolute balance between fuel and air, it is by nature quite narrow between its marginal limits; so narrow, in fact, that one may consider it as but a line separating the broader field of oxidation and reduction. It is almost an impossibility in actual practice to operate an open-flame furnace on a theoretically neutral atmosphere, and even if such a condition could be effected, the task of determining it would be extremely difficult. For this reason, the selection of a furnace atmosphere is reduced to the problem of determining whether an oxidizing or a reducing condition is the better for the purpose in mind.

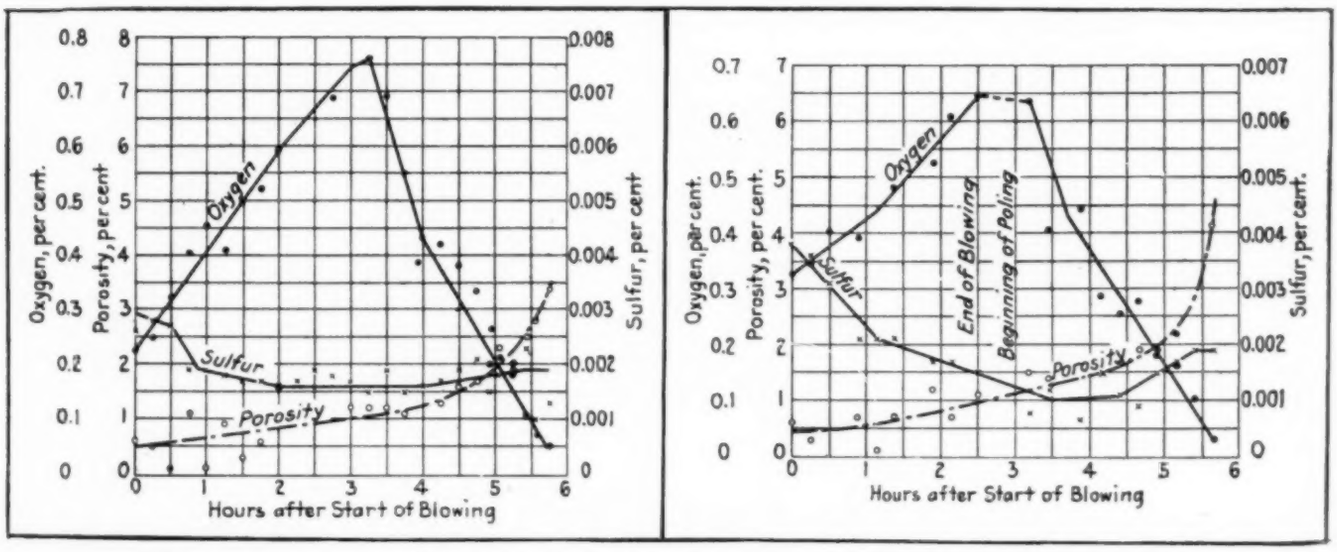
"Most bronzes readily absorb gas formed by incomplete combustion, the rate or amount of solution increasing rapidly with the increase in metal temperature, the duration of overheating, and the increase in explosion pressure of the incoming fuel. Considering the melting operation as being divided into two periods, (1) that in which the metal is raised from normal temperature to the temperature of liquefaction, and (2) that in which the excess heat necessary for handling and pouring is introduced, then the second period is the one in which a reducing atmosphere gives the greatest possibility of gas absorption.

"Since the most harmful effect of gas is due to its precipitation at or near the temperature of solidification, with a reducing atmosphere there is little danger of gas absorption during the first period. There is, however, in this period a possibility of the formation of sulphides, which subsequently may be absorbed by the melt. This possibility is not serious if the fuel is the only source of sulphur, for few fuels used for melting purposes contain as much as 1 per cent of this element. Assuming 130 pounds of oil as the amount required to melt 1000 pounds of bronze, then with a 1 per cent sulphur content, 1.3 pounds of sulphur must pass through the furnace. Not over one-tenth of this amount possibly could be absorbed by the metal, which would represent but 0.013 per cent of the 1000 pounds of metal melted. Such an amount in itself cannot be serious, but by accumulation through frequent remelting or by additions in some form with the metal charged the first period may be accompanied by considerable sulphur absorption.

"Though the absorption of gas and the absorption of sulphur are the two most harmful results directly attributable to melting with a reducing atmosphere, there are other indirect results just as harmful which should

Describes Gas Effect

INCOMPLETE combustion, sometimes used in nonferrous melting and resulting in a reducing atmosphere, produces gases which are readily absorbed by the molten alloys. The speed of solution increases rapidly with increase of temperature, and duration of overheating. However, when oxides are present, the effect of the gases is decreased. These features, the part slags play in melting, and some comparisons on the effect of gases on copper are included in this article which is the second of a series on unsoundness in red metals.



Figs. 12 and 13—Porosity Curves in Casting Refined Copper According to Wells and Dalzell

be considered. When the charge to be melted is made entirely or in part of secondary metal, there may be impurities which, if not removed, will cause defective castings. Small amounts of aluminum and silicon are almost sure to be disastrous. Iron and sulphur are objectionable. Even phosphorus, so generally used in nonferrous foundries, may cause considerable trouble with high-lead and high-zinc alloys. Such impurities are affected but slightly by melting in a reducing atmosphere, and may greatly aggravate and confuse the results of gas absorption.

"On the other hand, a reducing atmosphere may be highly desirable when the metal charge contains considerable metallic oxide. This is particularly true when the oxides are heavier than the resulting alloy. In such a case reduction may proceed over both periods of melting and absorbed gases may be rendered harmless by their action on submerged oxides.

"Turning now to the consideration of melting in an oxidizing atmosphere, we find the first and most serious difficulty to be the formation of oxides in the first period of melting. It is then that the metal charge presents the greatest surface to the action of the furnace flame. Small particles of melted metal dropping downward through the charge may be converted entirely into oxide. In most cases the oxide will attack rapidly the silica of the furnace lining, causing the formation of large amounts of slag and contributing to the heavy metal loss. In the second period this loss by oxidation is not so heavy because the slag formed in the first period serves as a protective layer to the melted metal.

Will Serve a Purpose

"However, this process of oxidation, if controlled, can be made to serve a definite and useful purpose. Fortunately the impurities are converted more readily into oxides than are the elements usually desired. If these impurities are not present in too great amounts, they may be rendered harmless by selective oxidation. Once converted into oxide, such impurities, being lighter than the metal bath, stay upon the surface and unite with the slag. In addition to this, the excess air of the furnace reduces to a minimum the danger of gas absorption by the melted metal. It does this in two ways: First, by greatly reducing the amount of soluble gas in the furnace, and second by reducing the solubility of these gases through the pressure of oxide in the melted metal.

"The solubility of hydrogen, carbon monoxide and sulphur dioxide in copper is reduced greatly by alloying with tin or with zinc. It is reduced still further by the presence of oxygen in the metal; the hydrogen and carbon monoxide being oxidized and the metallic oxides reduced. In the case of sulphur dioxide there is no further oxidation but the saturation point of the alloy for this gas is reduced in the same way that tin and zinc reduce the saturation point of hydrogen and carbon monoxide in copper. The burning of sulphur to sulphur dioxide in the furnace chamber does not render the sulphur of the fuel insoluble in the metal, but the oxygen taken up by the metal as oxide makes the solution of the sulphur more difficult.

"It would then appear that a slight amount of oxide in the metal is essential to the production of sound castings from open-flame furnaces when the metal to be melted is of the kind here considered. Just how the correct amount may be kept present is a question for which no hard and fast rules may be laid down. It is a matter of adjustment of practice to suit individual furnaces installation and metals to be melted. Oil-fired furnaces as a whole are claimed to give less trouble from gassed metal than do furnaces fired with gas. This is because the products of incomplete combustion with oil are largely carbon and carbon monoxide, while with gas, carbon monoxide and hydrogen may both be present.

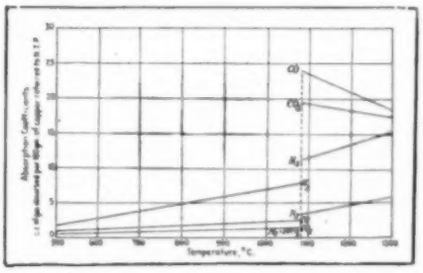


Fig. 14—Absorption Coefficients of CO, CO_2, H_2 and N_2 According to Iwase

"Hydrogen is absorbed much more readily by the metal than is carbon monoxide—in fact, many believe carbon monoxide to be practically insoluble—so that a fuel containing 50 per cent free hydrogen is much more dangerous from the point of gased metal than one containing practically no free hydrogen. The reduction of carbon dioxide to carbon monoxide by carbon is the only source of gas to be encountered in connection with the use of oil, as the possibility of hydrogen by the reduction of water vapor in the usual installation is exceedingly small. However, there is generally much more sulphur in oil than in gas and where metal is to be melted over and over, because of the percentage of gates and turnings produced, this factor may become of considerable importance.

"In preceding paragraphs it has been pointed out that there is considerably less danger of gas absorption in the first period of melting than in the second. By the use of a reducing atmosphere in the first period and an oxidizing atmosphere over at least a portion of the second period, the dangers of gas absorption and too severe oxidation may both be eliminated. The amount of oxygen left in the metal may be controlled by varying the length of the oxidizing period. In this way, metallic impurities may be removed to a large extent or held at a minimum, and the sulphur content materially decreased."

Gas Analysis Is Desirable

Most foundries judge the atmospheric conditions by the flame appearance alone. The use of an Orsat gas analysis apparatus to determine the actual percentage of carbon dioxide, oxygen, carbon monoxide and other gases is desirable. Also it should be pointed out that the reducing flame is slow and cold, the neutral flame fast and economical, while combustion engineers have found that a slight excess of air produces most rapid combustion and maximum heat under many conditions, especially in steam generating units.

The effects of various atmospheres are minimized by the intelligent use of slags. Glass makes a good slag, while recently fused sodium carbonate (soda ash) has been found of value. The latter is not as destructive on lining as might be expected. It forms a fluid slag which is handled easily, and as a rule melting losses due volatilization and slight oxidation are reduced considerably.

Recently a cupola using a special petroleum coke has been brought out for bronze melting. Oxidation and volatilization losses are said to be high, but these are claimed to be offset somewhat by the low cost of the melting operation. As melted, the metal is oxidized. However, when proper proportions of phosphor-copper are used as a ladle deoxidant, excellent bronzes are said to be produced. For example, the author has seen an 85-5-5-5 mixture with over 36,000 pounds per square inch tensile strength and a fine, dense fracture produced from the cupola.

Since direct arc furnaces of the heroult type produce intense local overheating, hence high volatilization losses, they have not been successfully applied to the melting of bronzes. The arc furnaces in commercial use are the indirect and muffled arc types. The most widely used furnace of this type is the indirect arc, rocking-type furnace. Such furnaces are claimed to effect rapid melting, and normally maintain a reducing atmosphere. Their melting loss is said to be low. R. J. Anderson and J. H. Capps in *Chemical and Metallurgical Engineering*, 1921, found the following conditions under normal operation in aluminum melting: Carbon monoxide, maximum 42.8 per cent minimum 1.5 per cent, and average 20.7 per cent. Bolton and Weigand,

Transactions of the American Institute of Mining and Metallurgical Engineers, 1929, found when melting bronzes that the gases were as follows: Carbon monoxide-maximum, 68.6 per cent; minimum, 1.1 per cent, and average, 25.0 per cent; carbon dioxide-maximum, 16.5 per cent; minimum, 4.8 per cent, and average, 10.0 per cent; oxygen, trace. The size of the furnace, whether or not the door is open, the time the sample is taken during the heat and like factors, influence the atmospheric conditions.

St. John, Eggleston and Rynalski, *Technical Publication* 300-1930, American Institute of Mining and Metallurgical Engineers, have pointed out that under certain conditions, silicon contamination may be obtained from the lining of the indirect arc furnace. Some linings do this more than others, the silicon carbide

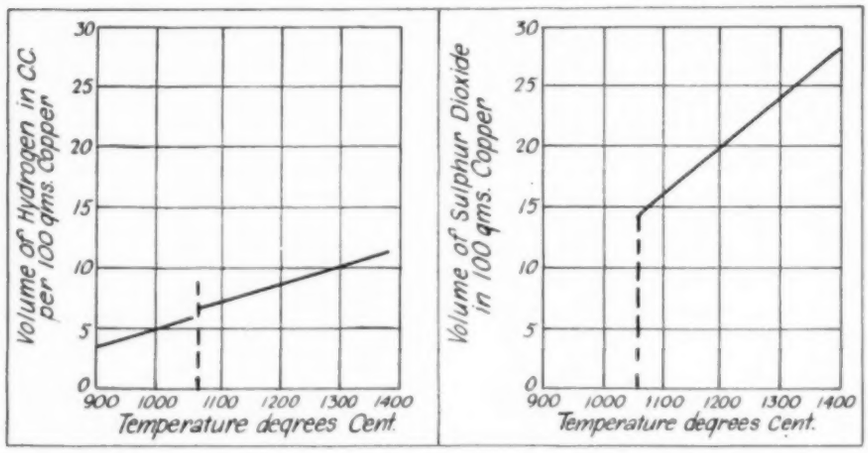


Fig. 15—Solubility of Hydrogen in Copper. Fig. 16—Solubility of Sulphur Dioxide in Copper. Both According to Sieverts

refractories being viewed with particular suspicion. As shown the effect is particularly severe if oily turnings or other carbonaceous matter is added with the charge, or when the furnace is operating with a smoky hissing arc. The authors state that a selective oxidizing agent should be added to the metal, to offset reduction of silicon from the lining. Barium sulphate is recommended for that purpose. Copper oxide and lead oxides have been suggested by others.

Two other types of electric furnace are coming into the bronze melting field in this country namely the low frequency induction type furnace and high frequency induction type furnace. It is only recently that the manufacturers of the low frequency induction type furnace have developed a refractory that will resist red brasses, although the furnace has been used successfully in yellow brass melting for several years. Apparently there should be little chance for atmospheric contamination within this furnace. The high frequency induction type furnace was introduced quite recently, and to the author's knowledge has not been widely applied in commercial bronze melting. Since vacuum melting may be conducted that furnace offers interesting possibilities.

While they cannot be considered strictly analagous, some features of the fire refining processes employed in production of copper permit some interesting comparisons to bronze melting processes since the bronzes contain 80 per cent and upward of copper. It has been known for many years that good tough pitch copper contains a small percentage of residual oxygen. Molten copper will absorb a considerable percentage of cuprous oxide, Cu_2O, which forms a copper-copper oxide eutectic. When this exceeds a certain amount the metal is brittle, and the fracture a dull red, showing that an excess of oxygen has a deleterious effect. However if good molten copper is kept under charcoal a sufficient length of time, or exposed to a carbon monoxide atmosphere long enough, the metal becomes brittle after solidification. That condition is commonly termed, *overpoled*. In extreme cases the metal spirts during the freezing period and after solidifying the surface usually shows small irregular tube-like cavities through which the gas seems to have escaped. This *overpoled* condition can be remedied by sufficient reoxidation to insure a small percentage of cuprous oxide in the metal.

It is claimed by some that electrolytic grades of high purity are not affected easily by holding under charcoal. The presence of small amounts of impurities may have some influence on the reaction. Some authorities claim that possibly these impurities from metallic solid solutions under reducing conditions are changed to their oxides under oxidizing conditions and become innocuous. However gas absorption is a more likely explanation, since certain cases show actual rejection or spitting of gases. Furthermore, it is held that copper absorbs various gases, such as carbon monoxide, hydrogen, carbon dioxide, nitrogen, sulphur dioxide, etc. As demonstrated by Iwase in *Science Reports* of Tohoku Imperial University, 15-531, 1926, and illustrated in Fig. 14, the solubility coefficient is lowered markedly at the solidification point. This necessarily results in gas rejection.

Carbon Gases Not Soluble

However Sieverts and Krumbhaar, *Berichte*, Deut. Chem. Gesell. claimed that carbon dioxide and carbon monoxide are not soluble in molten copper. On the other hand Caron, and later Hampe found that molten copper cooled in a carbon monoxide atmosphere produces porous metal. Hampe shows that carbon dioxide atmosphere produces sound copper. Johnson, *Engineering*, 1918, says that when oxygen is present other gases are less soluble in molten copper. When oxygen is absent or is present in insufficient quantities, the copper dissolves other gases such as hydrogen and carbon monoxide, which are insoluble in the copper when solid, and being rejected during the process of solidification, cause internal porosity and external excrescences and ridges.

Wells and Dalzell, *Technical Publication* No. 270-1930, American Institute of Mining and Metallurgical Engineers, claim, "***hydrogen carbon monoxide, water, carbon dioxide and nitrogen are evolved on solidification. In order of decreasing severity of effect on porosity, they may be listed: Carbon dioxide, carbon monoxide, nitrogen, water and hydrogen. In practice however, nitrogen probably has the principle effect from this source as it constitutes about 60 or 70 per cent of the gases in contact with copper. During poling each particle of cuprous oxide is attacked by reducing gases forming carbon dioxide and water at the surfaces of the particles where they are held by absorption. On solidification, then, porosity is caused; (1) By gases which have been held in solution in molten copper and liberated on solidification; (2) by gases adsorbed at the surface of cuprous oxide particles and liberated as the surface area of the cuprous oxide is reduced by agglomeration." Figs. 13 and 14 represent the porosity curves in casting refined copper.

All these experiments usually conducted on a laboratory scale, must be interpreted with caution in terms of works practice. The latter researches indicate the absorption of carbon monoxide. In this they confirm the inferences of practical observation. Ellis, *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1929, claims that casting copper melted under reducing conditions contains carbon di-

oxide, nitrogen and water vapor, hydrogen and carbon monoxide being absent. On the other hand Sieverts, *Berichte*, Deut. Chem. Gesell, 1910, found that molten copper can dissolve a considerable quantity of sulphur dioxide and a smaller quantity of hydrogen. In each case the solubility apparently is proportional to the temperature and to the square root of the partial pressure of the gas. Seiverts checks Iwase in showing sharp discontinuities at the melting point; as shown in Figs. 15 and 16.

Gases React With Oxides

Referring to the results obtained by Ellis it may be that in starting with regular copper, containing some oxide, his methods of sampling and analysis would show carbon monoxide as part of the carbon dioxide, and hydrogen as water vapor, because of the reactions encountered when the reducing gases react with the oxide present in the metal. Skowronski, *Transactions* A.I.M.E., 1919, claims that sulphur is the direct agent in the overpoling of copper and that it is impossible to overpole copper if it does not contain sulphur and possibly reducing gases. Gill questions that statement and says that it is necessary to obtain a proper balance between reducing gases, especially hydrogen and carbon monoxide and the neutralizing cuprous oxide. In heavy castings overpoled copper is obtained in virtual absence of sulphur. In investigating the action of reducing gases on hot, solid copper, Pilling, *Transactions*, A.I.M.E., 1919, found internal fractures produced by the expansive action of a gas which is formed by the reduction of each oxide granule. Carbon monoxide and hydrogen are the principle offenders.

The critical period, during the production of sound (or unsound) bronze and red brass castings is the solidification period, the transition from liquid to solid. During freezing there is an alteration in volume between liquid and solid. This is often termed *liquid shrinkage*. In the type of alloys under consideration the temperature interval between initial crystallization and complete solidification is considerable. In heavier sections the time interval is prolonged. This allows rejection of any gases present, the formation of coarsely crystalline structure, and the separation of compounds or of eutectics whose contraction characteristics may vary from those of the rest of the metal. Furthermore during the freezing range solid and liquid phases are present simultaneously, the intermixed crystals and liquid forming a pasty condition which it is obvious, is not particularly helpful to the feeding of the casting, and which may prevent the escape of any gases which may be generated. These conditions have been nicely described by Dews, *Foundry Trade Journal*, March 7, 1929, as follows:

"It can be said—that the porosity is due to the (net) effect of two peculiarities of the freezing. In the first place bronze freezes over a range of temperature, and secondly, it contracts in volume during the process of freezing. When the outside of a mass of molten bronze reaches the temperature of the commencement of solidification, only a portion of the outside layer solidifies and the bulk of the layer remains liquid until the temperature has fallen considerably below the temperature of the commencement of solidification, and has started to solidify, and so on,—it can be seen that solid material has started to form a good way into the casting before the first layer has passed through its pasty stage.

"The first stage in the freezing of the outside layer is the formation of a network of solid metal (dendrites) and from this network arms of metal then grow into the liquid interior. From these first arms, or dendrites as they are called, as the temperature falls smaller dendrites branch off at right angles, first at the base, and then gradually up the length of the shoot. From these secondary branches a third set of branches then grow out again at right angles. With each fall of temperature the spaces between the branches are being filled in making the trees of solid metal gradually thicker at the bases while the tops are continually pushing downward into the liquid.

Leaves Voids between Dendrites

"Now, during this process of freezing bronze contracts considerably. The solid metal occupies less space than the liquid from which it is formed. The formation of each branch of solid metal tends to leave a space beside it. While any liquid metal is available, it will flow up to the dendrites and fill the space left by the solidification contraction. If for any reason liquid metal is not available, then voids will be left surrounded by solid metal. In the resultant castings these voids will be found in shape of the outline of partly formed dendrites.

"Contraction cavities will not form if liquid metal continually is available to flow up to the solidfying dendrites. (Author's note—unless gas rejection already has filled these spaces) ***Even when a supply of liquid metal is available it has to flow through a maze of dendrites to fill up all the spaces. It is advisable, therefore, to shorten its path as much as possible, to be sure that it is adequately fluid, and that there are no mechanical obstructions to impede its easy flow.

"The longer the freezing range for a given value of contraction and the more difficult it is to cast the alloy free from porosity. ***the feeding liquid will have to traverse a thick maze of dendrites to fill up the last cavities. It is thus desirable that the freezing range should be as narrow as possible.

"Small amounts of phosphorus materially lengthen the freezing range by depressing the temperature at which freezing is completed without a proportional lowering of the temperature at which freezing commences." Dews later indicates that there is plenty of evidence that an oxidizing atmosphere is essential to produce good quality bronze.

Assumptions Are Made

As pointed out by Bolton and Weigand, *Transactions*, A.I.M.E., 1929, porosity traceable to mechanical means alone as previously described, assumes (1) vacuum or reduced pressure spaces or (2) presence of gases (in these spaces) which must be displaced or reabsorbed. In an earlier paper they indicated that crystallization, initiating as indicated by Dews, is followed by greater gas saturation in the mother liquor which becomes more and more nearly saturated with gases. At the moment of solidification their solubility is greatly diminished. Suppose that the saturation is excessive for solid metal, and that gases are rejected at the crystal interstices. This prevents feed of metal—causes incipient shrinkage by preventing feed through back pressure (of the rejected gases) rather than by pulling away metal as thin section would. Or—when the metal is just saturated with gases contraction sets in the plastic metal. Pressure is lowered—there is a force for evacuation—then some of the gas is freed more readily. This allows the contraction to pull apart the plastic crystals all the more easily.

Since the metal in this pasty condition is weak and not so ductile, hard cores or too heavily-rammed, high-bond sand-molds may resist the shrinkage of the contracting metal enough to cause it to tear, to become partially disintegrated—resulting in cracks and certain types of porous areas.

The cooling rate depends on the pouring temperature of the alloy, the relation of volume to surface area in the casting, that is on section size, on the conductivity and temperature of the mold, on the specific heat and the conductivity of the alloy (liquid and solid), the use of chills and like factors. The cooling range depends on the analysis of the alloy, on the presence of impurities, etc.

Kratz & McClelland, San Francisco, have been appointed agents of the G. H. Williams Co., Erie, Pa., manufacturers of buckets and trailers. Complete stocks will be carried in the warehouse at San Francisco.

Fundamentals of

FOUNDRY PRACTICE

Detailed Instructions Are Given, Essential To the Production of Molds for Several Typical Large Castings

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part XVII

WHERE the diameter of a flywheel exceeds 9 or 10 feet and no large flask is available, the mold may be made in the floor and covered in sections either with cores or with a number of small copes. Where the small copes are employed the mold is set up in the usual manner with suitable marks on the joint to outline the rim and arms. The joint on the inside of the wheel is made in a horizontal plane corresponding to the center line of the arms. The upper joint on the outside is made flush with the top of the rim of the wheel.

Molds Flywheel

The pattern of the half-spoke is set in place, and covered with a small cope in which the bars are cut in a manner to clear the arm pattern as shown in Fig. 211. Overhanging grids or arbors *a*, *a*, are attached to the ends. The flask is provided with four handles *h* and the guides *G* against which the stakes are driven.

Two boards *P P*, Fig. 211, are arranged on the sides of the core frame of the hub, to form a complete core when all the flasks are assembled.

When all the copes have been rammed and lined up, the mold is finished, blacked and dried. The lower part of the spoke is bedded in the drag, in the usual manner.

Instead of a flask, a corebox may be used with a piece of the hub and a half arm pattern attached. The necessary number of halves are made and assembled in pairs and then placed on a sand bed. The spaces between the arm cores are filled with sand rammed in place. The joints inside the hub are daubed with loam.

The outside of the rim is swept in loam. Dig a trench of 2 feet in width or even more, so that a man can work in it. Lower the sweep as shown in Fig. 213. Sweep the bed and outside of the rim carefully, making sure with the fingers that there are no soft spots. Smooth up and black the surface. Dry out by a hot air blower, or by a coke fire in the bottom of the pit. The mold face being protected by a row of bricks. Better still, dry it out by perforated sheet iron fire baskets filled either with charcoal or coke.

Remove the spindle and put a small coke-fire basket in the hub to dry it. Cover the hub with a cast-iron plate loamed on the face and provided with the necessary openings for gates, vents and risers. The pulley rim is covered with a loamed ring or with a number of cores.

On flywheels with rims of rectangular section, the mold is made all in sand. The cope is formed of cast-iron core arbors covered with loam. The sides of these cover cores are tapered to fit into the sloped joint made with the drag sweep without the need of placing reference marks.

Each of these cover cores fits over an exact division, a sixth, an eighth, etc., of the rim. A section of the rim with one of these cores in place is shown in Fig. 214.

Provided with Sockets

Large flywheels and flywheel pulleys are provided with sockets on the outside or inside of the rim by which, if necessary, they may be levered past a dead center and started into motion.

Two methods are available for forming these pockets. In one a small finger attached to the sweep, forms a continuous coreprint to receive the cores containing five to six teeth. One of the cores in place and the corebox for forming the cores, are shown in Fig. 215.

In a second method, the spaces are stepped off with a pair of dividers and cores are attached to the surface with nails at the indicated points as shown in Figs. 216 and 217. This method is rather inaccurate.

Molding of pulleys and flywheels with two rows of spokes does not involve any difficulties. The part of the mold containing the lower row of spokes is molded first and dried. Then a second joint is swept at a suitable distance which has been check-marked by placing a reference mark. This reference mark is nothing more than a piece of wood representing the distance from axis to axis, of the two rows of spokes.

Heavy Castings

PRESUMING that the student has progressed to a point where he has a fairly comprehensive knowledge of the principles involved and that through practice, he is familiar with the tools, materials and appliances of the foundry, the author in this section introduces him to the methods and equipment employed in the production of large gray iron castings. The examples presented for explanation include a flywheel, a pipe and a bedplate and several alternative methods are described for the construction of the mold for any of these castings under varying conditions. In some instances these descriptions are presented more to develop the student's ingenuity than for their practical application under ordinary modern foundry conditions.

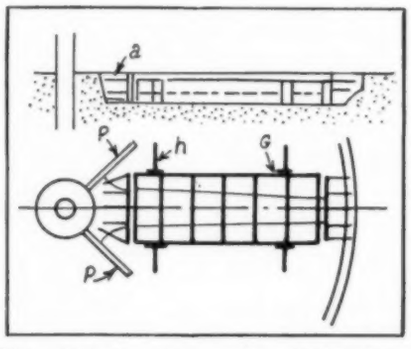


Fig. 211—A Cope with Extensions Carries the Sand Over Each Arm

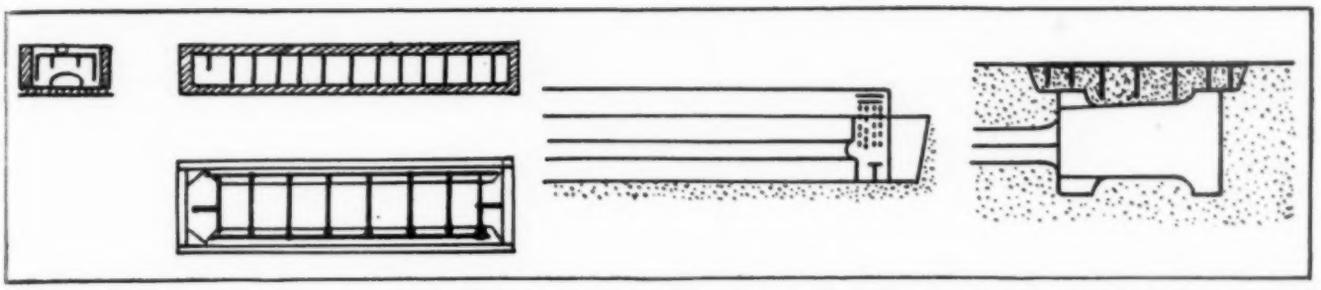


Fig. 212—The Cast Iron Arbor Is Rammed with the Sand in a Corebox. Fig. 213—The Joint Outside the Arms Is Swept. Fig. 214—The Rim Is Covered with a Core Divided into a Suitable Number of Sections

It is placed vertically over the first joint.

A better method is to take a sweep made up in two pieces as shown in Fig. 218 and sweep the first joint to the level of the axes of the spokes if the arms are to be bedded in, or, to the lower side of the arm cores, if dry sand arm cores are to be used.

wall still more strong and resistant.

In molding with templates and strickles the sweep takes the name of a strickle, and instead of developing circular forms by rotating a sweep about a spindle, the strickle slides along one or more wooden frames called templates. Straight, curved or *T*-shaped pipes, foundation

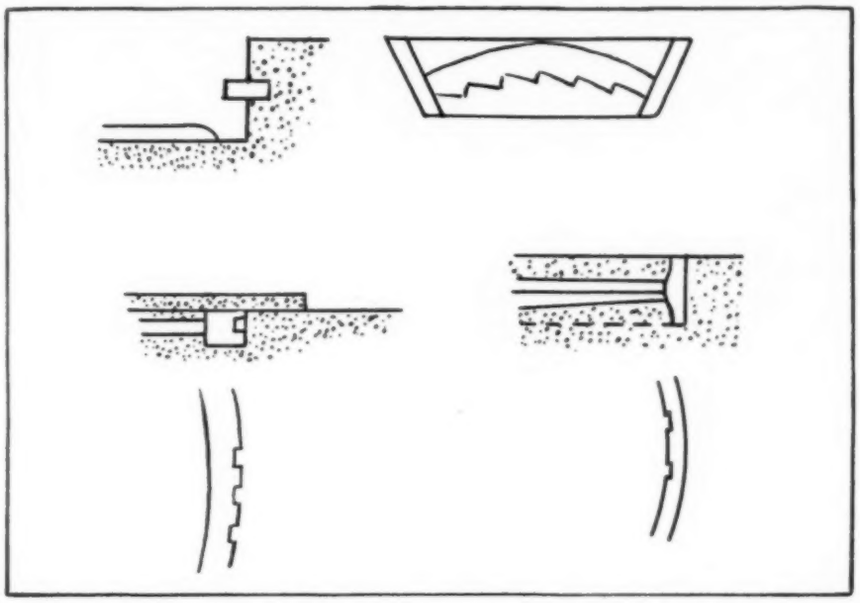


Fig. 215, 216, 217—Several Alternative Types of Cores Are Employed To Form Starting Bar Pockets in Flywheels

When the first part is finished and dried, sand is rammed to a sufficient height for the second joint. The lower part of the sweep is removed and the remainder of the sweep forms the second or upper joint.

The sand around the lower part of these flywheels must be rammed firmly to resist the pressure exerted at the time of pouring. In some cases, it is advisable to bed in several rows of pig iron to make the

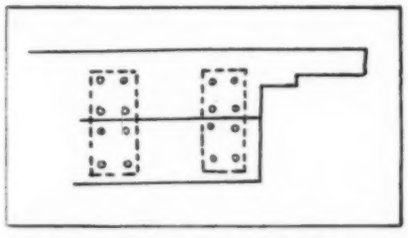


Fig. 218—This Sweep Forms the Upper and the Lower Joints

plates, engine beds, etc. may be molded according to this method.

To mold a straight pipe, according to the first method: the molder secures two flange patterns, right, Fig. 220, split through their diameters and assembled by dowel-pins. The lower halves are fastened together with two wooden straight edges, *D.D.* Fig. 220, about 3 inches wide, ¾-inch thick and about 90 inches in length, with the required distance between the two flanges.

A trench is dug in the floor and the flanges are rammed in place, level, true and parallel with each other. A suitable bearing, a brick or a piece of iron, is bedded about 4 inches outside each flange to serve as a bearing for the core arbor. The entire trench is rammed full of sand for pipe up to approximately 24 inches diameter. Above that size some time is saved by placing *dummies*, boxes, barrels, or bottom boards on the inside and ramming the sand on the outside of the proposed body of the pipe.

With the sand rammed flush with the top of the strips holding the flanges together, the strike No. 1, Fig. 221 is employed to form a cavity which conforms to a corebox. The face is covered with wet parting sand or with sheets of paper and the core arbor is adjusted with the outer wings resting on the bearings and with the wings on the inside showing a clearance of approximately ½-inch. The arbor may be all in one place with the semicircular wings cast integral with the backbone, or, the wings may be provided with rectangular openings and fastened to the backbone with wedges. On pipe up to 4 or 5 feet in length, a stiff cast-iron arbor will prevent the core from sagging or rising. Over that length a chaplet on top is required for each 4 feet in length. Thus on lengths between 5 and 8 feet, one chaplet is required in the center. On a 12-foot length, two are required. A pier built up from the arbor forms a resting place for the chaplet. No chaplet is needed on the bottom. The lift of the metal will compensate for any sag.

Sand is rammed around and over the arbor to a height corresponding to the height of the upper half of the pipe, in this instance 8 inches above the joint. This mound of sand is formed to the correct shape with the strike No. 2. Strike No. 3 is employed to form the sand prints outside the flanges. The sand corresponding to the pattern, also the flat joint of the mold, then are covered with parting sand and a cope is rammed, removed, and finished in the usual manner.

Strike No. 3 then is employed to remove a thickness of sand corresponding to thickness of the casting from the upper half of the core. The

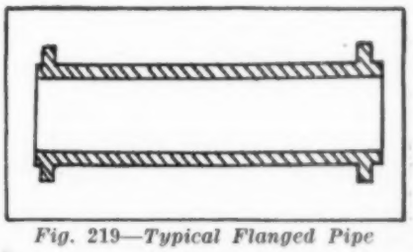


Fig. 219—Typical Flanged Pipe

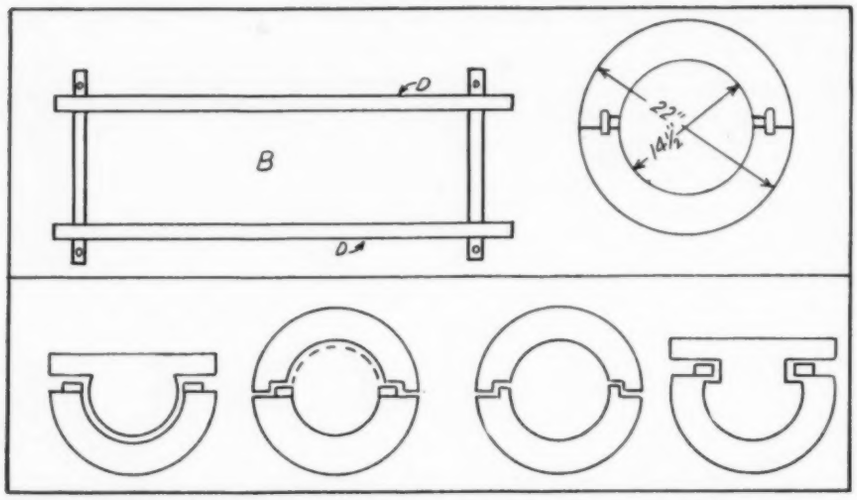


Fig. 220—(Above)—Two Straightedges and Pair of Flanges Constitute the Pattern Equipment. Fig. 221—(Below)—The Core and Mold Are Formed with Four Sweeps Employed in the Order Shown Reading from Left to Right

core then is lifted out of the mold and finished. In some instances, particularly on large pipe, the entire core may be placed in the oven and dried. Usually a skin drying on the bottom is sufficient. In the present instance the core is reasonably safe without either a partial or entire drying.

With the cope and the core out of the way, strike No. 4 is employed to remove a thickness of sand from the drag face of the mold corresponding to the thickness of the metal in the pipe. The flanges then are removed and after the drag has been finished and brushed with a coating of plumbago, the mold is reassembled.

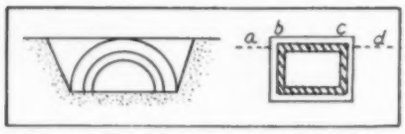


Fig. 222—The Joint on a Cylindrical Pipe Is Formed Along a Center Line. Fig. 223—The Joint on a Rectangular Pipe Is Formed at the Top

Where a cope with plain, flat bars must be employed, a parting is made as shown in Fig. 222. However, this rarely is necessary, since copes usually are available with the bars cut out to receive the upper part of the mold.

To mold a straight flanged pipe with a loam pattern, a loam core first is swept on a core-barrel with a straw or hay rope center. After it is dried it is covered, with the exception of the prints, with a layer of loam and straw rope between the flanges to obtain the outside diameter of the pipe. The necessary flange patterns are adjusted in place and the mold is made as with a wood pattern. While the molder is patching his mold, the coremaker removes the excess thickness from the core.

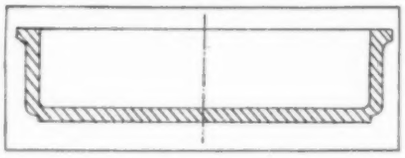


Fig. 224—Section of a Bed Plate Molded in the Position Shown

The process used in molding curved flanged pipes practically is the same as that used for molding straight pipes. However, it should be noted that: The template or strips connecting the flanges, follow the shape of the pipe. The core arbor is provided at the center of the curve with a staple. The sling chains support the core by its nds, and an additional chain with a turnbuckle regulates the position of the center of the core.

Tees and crosses also may be molded in the same manner. The core can be made of sand. However it is much cheaper to use one long straight loam core and two short lengths.

In molding of pipes of rectangular cross-section, the joint is made as in Fig. 223 on the upper part of the pipe, along the line *a b c d*. The core is molded in sand or in loam and, if necessary, with plates imbedded for supporting the core chaplets.

To mold a bed plate or similar casting shown in section in Fig. 224, any one of four methods can be applied. In the first or standard method, usually employed, the molder should have a template *A*, Fig. 225, following the outside contours and two strikes *B* and *C*.

Sweep the Bed

A level bed of sand is swept or struck up on which the template *A* is adjusted with suitable stakes which guide and hold it in place while using the strikes *B* and *C*.

The strike *B* is employed first to form a cavity corresponding to the inside of the casting. The templet *A* is removed and a cope is rammed, removed and finished in the usual manner. The templet then is replaced and the second strike *C* is employed to remove a thickness of sand corresponding to the desired thickness of metal in the casting.

The sand remaining on the center of the bottom may be removed with the trowel, with a small straightedge, or with a straightedge suspended from a long straightedge supported on the templet.

In a second method, more advantageous than the first, the molder should have on hand a templet as in the first instance conforming to the outside contour Fig. 224 and a strike similar to *C* Fig. 225. The

(*Concluded on Page* 123)

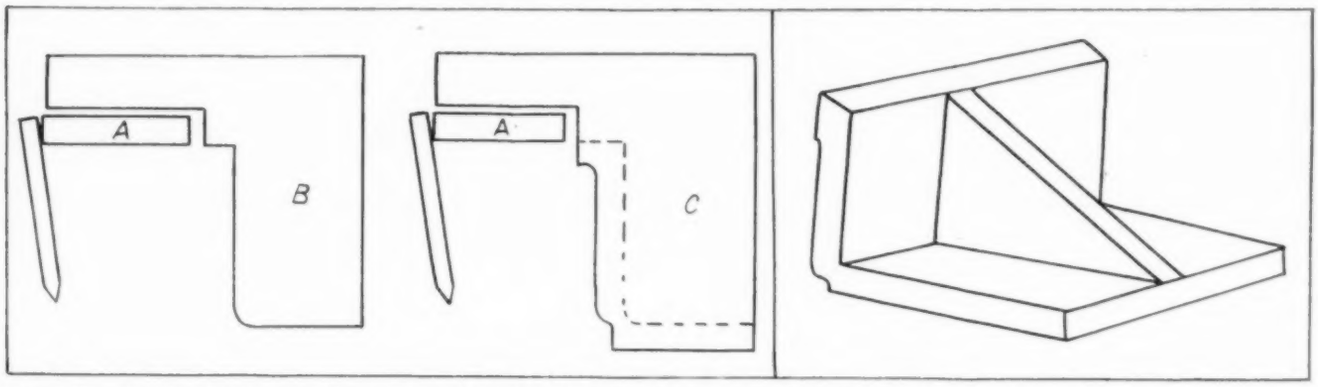


Fig. 225—(Left)—Sweep and Frame for Forming the Inside of the Mold. (Center)—The Same Sweep with Extension for Forming the Outside. Fig. 226—A Segment Piece Employed for Forming the Outside Face of the Mold

The FOUNDRY Family Photograph Album

Upper Left

JOHN HILL

Hill & Griffith Co., Cincinnati

Upper Right

L. S. PEREGOY

Sivyer Steel Casting Co., Milwaukee

Lower Left

F. T. SISCO

Alloys of Iron Research, Engineering Foundation, New York

Lower Right

T. F. JENNINGS

Utah Copper Co., Salt Lake City, Utah

PROPOSED TENTATIVE SPECIFICATIONS FOR

Magnesium-base Alloy Sand Castings

1. These specifications cover commercial magnesium-base alloy sand castings having a specific gravity of 1.9 or less. Three typical alloys are specified and are designated Alloys Nos. 1, 2 and 3.

Note.—Alloy No. 1 is the most widely used alloy, and is recommended for general casting work.

Alloy No. 2 possesses a higher yield point and greater hardness. Considerable latitude has been allowed in the chemical composition, as similar properties in the cast alloys can be obtained from different compositions. The copper content should be kept low where maximum corrosion resistance is desired.

Alloy No. 3 has a thermal conductivity 50 to 75 per cent greater than Alloys Nos. 1 and 2, and is recommended where this property is of great importance.

Table I

Chemical Requirements

Alloy	Magnesium, minimum, per cent	Aluminum, per cent	Manganese minimum, per cent	Copper, per cent	Cadmium, per cent	Silicon Maximum, per cent	Remarks
No. 1	90	5.5 to 8.5	0.2	0.1	1.0	0.2	Other metals 0.3 per cent
No. 2	87	8 to 12	0.1	....	....	0.2	Copper 2.5 per cent other metals 2.5 per cent
No. 3	91	1.7 to 2.3	0.2	3.5 to 4.5	1.6 to 2.4	0.2	Other metals 0.3 per cent

Manufacture

2. The alloy may be made from virgin metal or from purified scrap metal of known composition.

3. Castings may be subjected to such heat-treatment as the manufacturer desires to produce material that will conform to the requirements specified. Heat treatment shall be performed on the whole of a casting, never on a part only, and shall be applied in a manner that will produce the utmost uniformity.

Chemical Composition

4. The alloys shall conform to the requirements given in Table I for chemical composition.

This is abstracted from a proposed tentative specification submitted at the meeting of the American Society for Testing Materials held in Atlantic City, N. J., June 1930. Criticisms are solicited and should be directed to J. A. Gann, secretary of committee B-7 on light metals and alloys, cast and wrought, The Dow Chemical Co., Midland, Mich.

(*Continued on Data Sheet No.* 828)

PROPOSED TENTATIVE SPECIFICATIONS FOR

Magnesium-base Alloy Sand Castings

(*Continued from Data Sheet No.* 827)

5. (*a*) The sample for chemical analysis may be taken either by sawing, drilling, or milling the casting or tension test specimen and shall represent the average cross-section of the piece.

(*b*) The saw, drill, cutter, or other tool shall be thoroughly cleaned. No lubricant should be used in the sampling operation.

Physical Properties and Tests

6. The castings shall conform to the requirements given in Table II for tensile properties.

Table II

Physical Properties

Alloy	Condition	Tensile strength, minimum, lb. per sq. in.	Elongation in 2 in., minimum, per cent
No. 1	Sand Cast	24,000	4
	Sand Cast, Heat Treated	29,000	6
No. 2	Sand Cast	20,000	0.5
No. 3	Sand Cast	21,000	2

7. The test bars shall be separately cast in green sand and shall be "cast in size" according to the dimensions shown in the accompanying illustration. They shall not be machined prior to test except to adapt the grips to the holders of the testing machine in such a manner as to insure an axial load.

8. (*a*) The tests shall, so far as possible, be made by heats or melts, but unless otherwise agreed upon, two tension tests shall be made for each unit of 500 pounds or fraction thereof.

(*b*) If any test specimen shows defective machining or develops flaws, it may be discarded; in which case the manufacturer and the purchaser, or his representative, shall agree upon the selection of another specimen in its stead.

Workmanship and Finish

9. The castings shall be of uniform quality and condition, free from cracks or other injurious defects, and shall be well cleaned before inspection by sandblasting, tumbling, chipping, pickling in sulphuric acid, or other approved process.

(*Concluded on Data Sheet No.* 829)

THE FOUNDRY DATA SHEET, SEPT. 1, 1930

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Calculates Losses

QUESTION

We have been using a proprietary parting compound, but recently our foundry foreman began using finely sifted sand from the tumbling mills. Is this practice a good one? Also can you give us any data on losses which will indicate good practice in castings midway between stoveplate and light ornamental work as follow: (a) What percentage should be the weight of good castings to the total melt? (b) What percentage of the good plus bad castings should the good castings be? (c) What is the correct way to figure loss percentage; should the weight of bad castings be divided by the total melt or by the weight of good plus bad castings? (d) What is the general practice used in this connection? (e) What should be the percentage of over iron of the total melt? (f) What should be the percentage of sprues and gates of the total melt? (g) What should be the percentage of shrinkage?

ANSWER

The main purpose of a parting material is to prevent the damp sand from sticking to the pattern or to the opposite face of the mold. The material used is one that will not absorb water to any appreciable extent, and since finely ground dry sand has this property to a certain degree, it is used for this purpose in many foundries. It is not always suitable, but that is determined by experiment. Use with discretion as too much parting sand or compound may allow some of it to be washed ahead of the molten iron and cause defective castings.

The percentage of good castings to total melt runs from 50 to 60 per cent generally. The remainder of the iron is lost up the stack or in the dump, in defective castings, in sprues and gates, etc. The percentage of good castings based on the total amount of good plus bad castings will run in the vicinity of 94 to 97 per cent depending on the skill of the men and the quality of metal supplied. General practice in figuring the loss percentage is to divide the weight of the bad castings by the weight of the good plus bad castings. The amount of over iron probably should be around 5 per cent and will depend on whether the iron is melted hot and fluid and the judgement of the pourers in taking just enough metal to pour a definite number of castings before it becomes too cold to flow satisfactorily. Another factor is the skill of the foundry foreman in determining the amount of metal required to pour off the day's heat. If he figures close enough, little iron will remain in the cupola to be dumped. The percentage of sprues and gates in extreme cases may run as high as 35 per cent of the total melt. This amount will depend largely on the size of the castings. If the castings are small, the metal in the sprues and gates will weigh as much and sometimes more than the metal in the castings. In your question of shrinkage, we presume that you refer to defects caused by shrinks. As far as we are aware, no allowance for this condition is made outside of that for defective castings. If this feature is prevalent, you should make a change in your metal mixture—say a reduction of phosphorus content, or perhaps the silicon—or examine the methods of gating the patterns. If the patterns change abruptly from heavy to light section, gating should be aranged so that the heavy sections will receive molten metal as they slowly solidify.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Core Mixtures Vary

QUESTION

What mixture would you recommend for a horn shaped core 3 inches square at one end and 1½ inches diameter on the other end, 12 inches in length. The metal thickness is about ¼-inch and we want a sand that will rap out easily.

ANSWER

From your letter head we note that you make iron, brass, bronze and aluminum castings, but you do not state which of these metals is poured into the horn castings. This is an important factor, since a much less refractory core will serve in an aluminum casting than is required in a similar casting poured in iron with a temperature approximately twice as high. A satisfactory mixture may be worked out from practically any kind of sand, therefore it is impossible to lay down a hard and fast rule for your guidance, since we do not know the characteristics of the sands available in your district, nor the kind of binder you have been accustomed to using. In many places cores with the general characteristics you describe are made from clean, sharp sand bonded with oil in the proportion of 1 to 50. In other places from 10 to 50 per cent new molding sand is added to the mixture. While in still other places a dry binder is substituted for the oil.

Some foundrymen reduce the cost to some extent by adding from 10 to 50 per cent old molding sand. The general result of adding the molding sand is to cut down on the amount of artificial binder, increase the smoothness of the skin on the inside of the casting and produce a core that will hold its shape in the green state. Its disadvantages are that it reduces the permeability, and lowers the strength and refractoriness. The subject of core mixtures is so extensive and so adaptable to local conditions, that it is out of the question to give a specific mixture that will suit every foundryman. For a more extended reference to the many variables we refer you to an article on core sand mixtures by O. W. Potter in the Aug. 1, 1928 issue of THE FOUNDRY, As an extreme example of the variations that exist between perfectly satisfactory cores, it is quite possible that a green sand core might suit your purpose just as well as one that is dried. Green sand will rap out the easiest of any, and the proportion of molding sand in any other mixture will determine the difficulty of removal.

GRAY IRON

Iron Is Not Hot Enough

QUESTION

Our cupola has a 40-inch shell lined to 28-inches inside diameter. The stack is 35 feet high from the drop-door and the charging door is at a height of 15 feet from the drop-door. The cupola is equipped with two rows of tuyeres. Each of the four bottom tuyeres measures 3 x 8 inches on the outside and flare on the inside to 3 x 12 inches. Each tuyeres of the top row measures 3 x 4 inches on the outside and flares on the inside to 3 x 6 inches.

The sand used for the bottom of the cupola is screened and then damped just enough to get it out of the dust state. After the sand bed is made we have a height of 10 inches from the top of the sand bed to the lower part of the bottom tuyeres.

We use machinery scrap charges in the following manner: First charge of coke, 400 pounds; first charge of iron, 1200 pounds; second charge of coke, 80 pounds, and second charge of iron, 800 pounds. The succeeding charges are the same as the second. As soon as the first charge of coke shows a good start we charge the rest of the iron and coke as high as the charging door.

The cupola has a good draft and we allow it to heat up for 1½ hours, without the aid of the blast. Five minutes after the blast is on it begins to show drops of melted iron and at six minutes it shows fast melting. Nearly all the melted iron of the 6000 pound heat comes out so dull that we can hardly pour sashweights. The iron comes out hotter in the last two taps but not enough for stove plate.

The blower has a 6-inch outlet. A five horsepower motor turns this blower at a speed of 2752 revolutions per minute. If we try to speed the blower any more the fuses of the motor will burn out. We do not have a pressure gauge. Do we need more air? If so, would it be advisable to use our blower at a faster speed? If not, we would like to know what size blower and its corresponding motor.

ANSWER

Hot cupola operation necessitates exact adjustment of fuel, blast and stock as well as a certain degree of skill based on observation and experience. The term hot iron is relative and from your description we believe that your operating temperature must be below 2600 degrees Fahr. Cupolas can be operated to give iron temperatures around 2750 degrees from the middle of the heat on and run as high as 2800 degrees in spots.

While you have not given the actual bed height, melting rate as now operating, and the quantity of air delivered, there are several things that lead us to suspect that your final bed may be too low, and that you are using too much air. We suggest that the following procedure, plus a little checkup with a pyrometer and further readjustment if necesary, will improve matters.

Establish some method of measuring the quantity of air supplied to the cupola. The heat generated in a cupola depends on proper quantity of air for a given amount of coke. Too little air means slow melting and dull iron due to the coke burning too slowly. With too much air the iron is dull and lifeless, and the slag often appears black when ground up. Such iron is oxidized, dirty and lacks fluidity.

One method of determining the quantity of air is to use a device which measures the volume of air supplied. Another method employs an automatic device for measuring the weight of air supplied to the cupola. The volume may be calculated from fan revolution and the static pressure. However, it is necessary to know the back pressure. The fan manufacturer can tell you approximately what the fan will deliver at a given speed if you give the gage pressure.

With a 10 to 1 iron to coke ratio from 24,000 to 26,000 cubic feet of air per ton of iron are needed. However, reasonably hot iron and some increase in melting rate may be obtained by using somewhat more air, but over 30,000 cubic feet per ton is not advised for a 10 to 1 ratio. A 28-inch cupola operating hot will not deliver over 2½ tons per hour, that is your 6000-pound heat should take about 1 hour and 12 minutes from the time the blast is put on until it is shut off. The air volume should be about 1000 cubic feet per minute.

The quality of your coke should be checked to see that it does not run over 10 to 11 per cent ash, and that it is a good foundry grade. If other foundries in your vicinity are using the coke successfully and the ash is not too high, the coke should not give trouble. However, coke that has been exposed in the open for six months or more often loses much of its life. Where coke must be stored for long periods, it should be kept under cover.

Since coke varies in density and in size, the weight of your first coke charge does not help in estimating the bed height above the tuyeres. The amount of coke below the tuyeres does not mean much. The second bottom should be open and not too wet. It should be rammed just enough to hold it in place. The second row of tuyeres may be blocked off as sufficient air can be supplied through the bottom row. If the fire is started with kindling, a fork or two of coke should be thrown on as soon as the fire is going briskly. As the wood burns away more coke should be added gradually, bringing the hot coke just above the tops of the lower tuyeres. When the coke has burned through pretty well, add enough more to bring the bed height 30 to 42 inches above the top of the tuyeres according to the time the stock will be left to soak. This height may be determined by lowering a rod of the correct length down from the charging door. For your condition 36 inches above the tuyeres will be sufficient. When charging is started do not leave all the tuyeres open or blow the bed. Leave the taphole, slaghole and peepholes open. These will give enough draft. Use uniform charges all through. Five hundred pounds of iron and 50 to 60 pounds of coke is better for a 28-inch cupola than the 800-pound charges you are using.

When you are ready for your iron start off with full blast. The time at which iron begins to drip down is not an accurate indicator of the efficiency of cupola operation. Allow the cupola reservoir to fill; tap out and continue operations maintaining a constant air volume. Check the melting temperature with an optical pyrometer and make any necessary changes.

Q & A

Radiators Contain Holes

QUESTION

We are having some trouble with our radiator sections in which blowholes appear after machining. These holes usually are at the end opposite the gate and this trouble mainly occurs in the larger radiator sections. The blowholes range in size from ⅛ to ⅜-inch in diameter and are usually shallow.

ANSWER

We assume from your description that you are referring to cast iron, hot water radiator sections that have hubs at both ends, but do not state whether the holes appear only on the

upper face of the hub, or whether they also appear on the inside of the opening. Another feature we would like to know is the interior appearance of the holes. If they are dull, they probably caused by sand being too wet or rammed too hard, etc. However, if the interior contains a shiny deposit of carbon, the trouble results from the cores.

In making radiators of the type mentioned, it often happens that the molder is a little careless with the peen or rammer and allows it to strike the sand over the hub. Since this portion of the casting extends above the rest of the surface, the sand at that place requires less ramming to bring it to the proper density. Consequently, the careless work with the peen or rammer makes the sand too tight and blows result. The only way to correct the trouble is to check the operations carefully.

If the interior of the holes appears shiny as mentioned, the difficulty can be traced to improperly vented cores. This may be due to a plugged vent in the core itself or failure to provide an exit from the vent in the core to the outside of the mold. Sometimes, the molder will neglect placing the vent plug on the hub of the pattern when he makes the cope mold. As the gases from the core have no easy exit, they kick back into the metal.

Q & A

Loses Yoke Castings

QUESTION

I am forwarding for your inspection a 6-inch yoke which shows a defect in the bore after machining. The pattern is mounted on a stripping plate and molded in a steel flask with an 8-inch cope and an 8-inch drag. The casting is poured through a single gate at the joint of the wide flange and a riser is taken from the top of the same flange. The cored hole in the small flange is 1½ inches diameter before it is machined to a diameter of 2 inches. I am wondering if the defect which shows up after the hole is bored, is a shrink hole and if a riser placed on the small flange would cure it. Analysis of the iron shows: Silicon, 2.18 per cent; sulphur 0.08 per cent; phosphorus, 0.17 per cent and manganese, 0.37 per cent. On a recent run nine out of ten castings were defective.

ANSWER

Basing our opinion on the character of the defect we are inclined to think that it is caused either by the mold or the core. It is not shrink hole. The most probable cause is a stiff neck on the core without a suitable vent hole through it. When this neck is surrounded by metal is sets up a slight commotion and this commotion prevents the metal in the vicinity from setting normally. The four green sand pockets of the mold surrounding the neck of the core may be responsible to some extent for the trouble. They should be vented freely with a wire to permit the easy and rapid escape of the steam when they are surrounded with molten iron. The vents in the cope usually give no trouble, but occasionally the value of the drag vents is defeated by a bottom board which fits the drag too tightly. The neck of the core might be increased in size with advantage.

MALLEABLE

Requires Careful Study

QUESTION

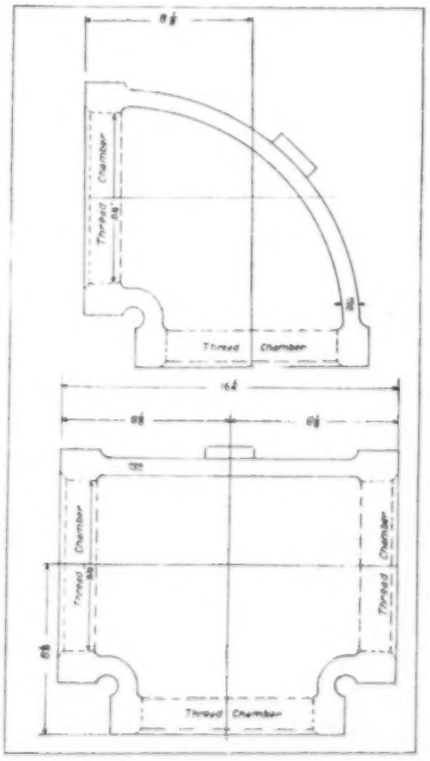
We are having trouble with our 8-inch malleable cast iron ells and tees which have to withstand 800 pounds per square inch working pressure, and which are shown in the accompanying illustration. Will you supply a small sketch showing the proper method of gating; shrinkers, risers, chills, etc. required to obtain solid castings? What mixture would you suggest for fittings of this size and character? We also have had some trouble with dirt in the thread chambers. How can that be eliminated? The molds are made on the floor using stationary flasks. Air furnace iron is used which is poured from 150-pound hand shank ladles.

ANSWER

The is no general answer to your question. Gating and feeding of difficult patterns is a problem that must be solved by a skillful foundry superintendent by study and experiment. Methods successful on one job may not work so well on another.

Pipe fittings are made more generally of cupola metal than of air furnace iron. If air furnace iron is to be used, a moderately high carbon, say 2.75 per cent might be preferable with a silicon content as high as possible without producing mottled structures.

The mixture probably will be nearly straight sprue and pig iron with little malleable scrap. The dirt complained of would seem to be due to either unrefractory core sand or careless cleaning. Pickling in hydrofluoric acid might be a help in either case.



Large Malleable Fittings Must Withstand High Pressures

STEEL

To Cast in Green Sand

QUESTION

In a recent issue of THE FOUNDRY I read an interesting article dealing with the production of steel bolsters and side frames in an American steel foundry in green sand molds. 1—What are side frames and bolsters? 2—Do you think green sand methods could be applied to casting of annealing pots and trays or stands employed in tin plate mills? Green sand is not employed to any extent in the steel foundries here and the pots and trays are imported. The local foundries do not care to make them. I have seen large pots somewhat similar to those described in THE FOUNDRY, Dec. 15, 1927, fall apart during the first heat, probably due to a rigid core which prevented proper contraction at the time they were cast.

ANSWER

On American railroads the cars are supported on two trucks. Each truck is made up of four wheels for freight cars and six wheels for passenger cars; two side frames and one or two bolsters depending on whether the truck is for freight or passenger service. The side frame—one on each side of the truck—is a steel casting resting on the journal boxes, which in turn rest on the ends of the wheel axles. An opening in the center of the side frame contain the springs which support the bolster, a second steel casting which extends from one side frame to the other and supports the weight of the car on a suitable pedestal in the center.

We are doubtful if large annealing boxes for sheet mills could be cast successfully in green sand. Up to the present we have not learned of any of these castings made in that manner. You probably are correct in your diagnosis of the pots which fell apart during the first heat. Proper allowance probably was not made in the mold for the castings to contract. In American foundries these castings are molded in dry sand, but the core is merely a shell which collapses readily under the contracting pressure of the metal. The mold is made in a three part flask with the high core resting on and forming part of the drag. The metal is introduced at the bottom.

Problems in Nonferrous Founding

By Charles Vickers

Makes Large Liners

We have had considerable difficulty making large pump liners out of various mixtures of alloys, principally 88 copper; 7 tin; 3 lead, and 2 zinc alloy. The trouble consisted of blowholes, both large and small, which were not visible until the first cut was taken from the castings. We deoxidized the metal before casting by adding one pound of 15 per cent phosphor copper for every 100 pounds of metal melted. The castings are 36 inches in length, 17 inches outside diameter with a metal thickness of 1⅛ inches, and with gates and risers removed the casting weighed 720 pounds. Both mold and core were of green sand, and were molded in a three-part flask having a 6-inch drag, an 8-inch cope, and a 36-inch check, the latter and the drag were of steel, but the cope was of wood. On the bottom of the drag we bolted an iron plate, which had no vent holes in it. We used ordinary brassmolders sand, and we tried four castings gating each one differently, the gates of three of them being on the bottom and one gated on top. Of the three gated on the bottom; one was gated with 2 gates embracing the bottom of the liner, like half-opened iceman's tongs. Another was gated with one gate set at a tangent to the circumference. A third was almost surrounded by the main runner, from which 5 gates were attached to the casting. The one gated on top had six entrances for the metal from the main runner which almost encircled the casting. The 1 per cent of phosphor copper was added only in one heat, which was made of all new metal. The others were cast of selected red brass scrap melted under a brass flux. The new metal came the worst of all. All the bottom-poured castings had a sprue 2 inches in diameter. The metal was melted in a No. 300 pot, oil-fired.

We suggest the following changes: (a) Get a more open sand for molding corresponding to a No. 3 Albany sand for future castings. (b) Have the steel cheek drilled through with ⅝-inch holes as profusely as possible, and have the holes staggered. (c) If bottom pouring is preferred, on no account use a sprue through the cheek larger than 1-inch in diameter. Through the cope make the sprue continuation 2 inches diameter, and bush it up 10 inches higher than the cope. At the cope joint set a second sprue 6 inches distant from the main sprue, cut this second sprue only through the cope and connect it with the main sprue by channel which will take the metal fast enough to fill the main sprue and keep it filled until the mold is filled. A double gate can be used at the bottom of the main sprue, but these gates should be cut thin, or choked. Keep the sprue full, for if it is not filled the falling stream of metal will carry air into the mold. Use cores at the bottom of the sprue, and also in the core where the entering streams of metal hit it.

Have the metal at 2100 degrees Fahr., and after the mold is filled to the top of the cope, put a bed of molding sand over the head, and on that a weight. Bring up hot metal from a smaller pot. Pour this slowly into the high head, filling it up, and fill it again as it shrinks down. If a skin dried mold is favored, face it with half new and half old molding sand mixed with flour in the proportion of 1 part to 20 parts sand, and spray with molasses water. Also the mold and core can be painted with plumbago wash and molasses water. In this manner bronze castings weighing a ton each and more are made and with from 6 to 8 inches of metal surrounding the core, no risers, or *break the fall* sprues are necessary. To deoxidize the alloy mentioned, more than 2 ounces of phosphor-copper to each 100 pounds of metal, is likely to prove injurious.

Q & A

Should Melt Hot

We would like some information regarding a special bronze bearing metal consisting of 70 copper; 25 lead and 5 tin. What would be a safe temperature for pouring such metal for a bushing weighing from 10 to 15 pounds.

The alloy given is a commonly used bearing alloy and no particular difficulty should be encountered in making it. As 30 per cent white metal is to be added to the molten copper, it is advisable in all cases to have the copper hot when the time comes for adding the lead and tin. The alloy no doubt will be made in crucible, so the copper should be melted first, and in the case of coke-fired natural draft furnaces, charcoal should be used to cover the liquid metal. Usually a few small hardwood blocks are placed on top of the solid copper, because in burning to charcoal they will give off gases that will protect the heated copper to a large extent, from the furnace gases.

Use deepeners on top of the crucibles. These protect the copper and also make it possible to charge all the copper at once into the crucible. Oil or gas-fired furnaces are not deep enough for the use of deepeners. However, they melt faster, and if the copper that cannot be put into the crucible is warmed there is no danger of spitting of metal when it is added later. It is necessary to follow up the heat constantly to make the additions at the proper time, which is before the first charged metal has become thoroughly molten. Bring the copper to around 2200 degrees Fahr., then add the lead and stir thoroughly. Next add the tin. Then again heat the metal to around 2250 degrees Fahr. Remove and pour around 2000 degrees Fahr. The lead should not segregate and will not if the melting has been one properly, but mistakes will happen. Should lead appear on the outer surfaces of the castings, use a flux consisting of 90 per cent plaster of paris and 10 per cent of calcined borax. Add about 1 per cent.

Q & A

No Standard Exists

We have been casting bronze bushings for one of our cutsomers. The castings have not proved entirely satisfactory. The customer claims that we are using the wrong mixture of bronze, whereas we contend that the cause of trouble is faulty lubrication. He has asked us to obtain your views on this matter, so we ask your opinion in regard to what mixture is used for piston end bushings for heavy duty stationary oil engines?

There is no standard mixture that we know of that is used for the purpose mentioned. The following mixture is considered standard for high speed and heavy pressure: 79.75 per cent copper; 10.00 per cent tin; 10.00 per cent lead and 0.25 per cent phosphor copper, containing 15 per cent phosphorus added as a deoxidant.

Bill Tells of Molding a Smokestack-IV

By Pat Dwyer

HAVE you ever had any ambition," I asked Bill the other night, "to take a stand on a street corner, or other public place, and harangue the multitude?"

"Certainly not," Bill said. "You know me, kid, a man of few words. I don't mind expressing an opinion occasionally, if the circumstances seem to warrant the exertion and if I am pressed. Mark that, my lad. If I am dragged into a conversation and can see no honorable means of escape, I may be persuaded to say a word or two. I get all the conversational exercise I want in the pursuit of my daily avocation. When I say exercise, I mean exercise.

"At one time a gaffer could get by in a shop with a fairly limited vocabulary. Every man spoke the English language. Many of them insisted on their own pet pronounciation while others took the most violent and unwarranted liberties with sentence construction, but it answered the purpose of maintaining communication. Brick bats never were mistaken for bouquets.

"If a man was told to light the vents, he dipped his skimmer in the ladle and then skilfully sprinkled a shower of red hot drops over the top of the cope or under the bottom board. If the gaffer told him to make half a dozen off a pattern, he made six. If he came in to work, pickled, and he was told to go get his time, believe me he went. Tell me, is it like that now?" Bill continued bitterly. "Yes it is, in a pig's eye! You tell a bird to light the vents and he either looks at you like a dumb ox or shrugs his shoulders and says 'Nixfurshtay.' You have to put the skimmer into his hands and then go through the required performance in pantomine. Tell him to make half a dozen off a pattern and unless you watch him like a hawk and take the pattern away when the six molds are made, he will bat away at them until quitting time. If for any one of 147 good and sufficient reasons you find it necessary to dispense with his company, you have to lead him by the hand into the time office and stand by while the clerk is handing him his money. Even then it is ten chances to one he is in his regular place again in the morning. Exercise! I'll tell the world its exercise. Besides trying to talk hunks of a dozen different languages every day, I have to indulge in more gestures than a one-arm deaf and dumb man describing a dog fight, or Tony Giorrchhio—pronounced Giorrchhio—explaining how he lost or won the wrestling match."

"You will pardon me," I interrupted, "if I am in error, but in a general way let us say, am I justified in assuming that you are opposed to the idea of—what is the word?—Ah!—Spouting from the stump?"

"'Pon my word," Bill said, "I'd hate to trust you with a skimmer! Here I tell you explicitly, clearly, concisely and in as few words as possible, how I stand on this question of street corner broadcasting.

"Instead of displaying proper, intelligent appreciation and gratitude for this brief, illuminating and direct answer to your more or less silly question, you blink your little weasel eyes in imitation of an owl and in effect ask me if I said yes or no."

"Well, if it comes to that, *did* you or did you not, say yes or no?"

"Yes or no, what?"

"Bill," I said, "the old memory is slipping. Soon, only too soon, you will be as bad as the old lady who said her memory was as good as ever except on three points. She could not remember names. She could not remember faces and she could not remember what was the third thing she could not remember!"

"Yeah?" Bill inquired pointedly. "Say, young feller-me-lad, lemme tell ya something. There are only two of us here and I am not the one who is shaping up as a candidate for the old ladies' home. You asked me first if I ever had any ambition to harangue the multitude on a street corner and I replied NO in a loud, manly voice. Then you twisted the question around and asked me if I was opposed to—your own words, mind you—if I was opposed to spouting from the stump. Without the slightest delay or equivocation and in one word I said YES. Now my boy, there is your yes and no, and what are you going to do about it, hey?

"What I should like to know," he continued, "is what prompted you to start this argument. Are you, by any chance, thinking of mounting a soap box down on the square and exposing your ignorance?"

"I thank you," I said, "for giving me the opportunity of showing you how a question should be answered. Instead of beating about the bush and wandering down blind alleys, dragging in extraneous material by the bushel, I look you straight in the eye and say NO. Just the one single word, NO."

"Well," said Bill. "You do not need to shout. I am not blind. At the same time I must admit that I fail to catch the connection between your valiant answer NO and my question, 'What prompted you to start this argument?' No one admires, or practices brevity more than I do, but I do not approve of carrying brevity to a point where it is not even as illuminating as a grunt from a Choctaw medicine man. With an ear nicely attuned, one can distinguish varying shades of meaning between grunts. Now, for example—" "Never mind the example," I interrupted, "I saw and heard an example today and—if it is any satisfaction to you—that prompted my ques-

Lots of Interest, But Not Much Co-operation

tion." "Ah," Bill exclaimed, "I thought that if I were to press you hard enough, just like pressing an almost empty tooth paste tube, I might squeeze something out of you. Now that you are properly squoze, squeezed or squizzen, perhaps you will continue to ooze a little more information. What did you hear, where did you hear it and what was it all about? I might add the when, why and how of the complete interviewer, but in this instance I shall be satisfied, surprised and satisfied in fact, if you come across with the what and the where stuff. On your marks! Get set! Go!"

"Take your time," I said. "Take your time. There is no hurry. Also kindly bear in mind that I am doing all the work. All you have to do—and certainly I wish you would pay more attention to the job—is to sit there and listen." "Nothing could be fairer than that," Bill agreed heartily. "Listening is my middle name. When I was a young lad they called me Silent Bill from the uncanny ability I displayed in saying less and hearing more than any two strong men in the community. You know that old rhyme about the wise old owl who lived in the oak. The less he spoke, the more he heard—" "You may have been an owl at one time," I admitted, "but if you were to climb into the branches now with the other tree sitters, you would not last an hour. Some public spirited citizen would come along with a shot gun loaded with bird shot or salt and shoot you for a magpie or a chattering parrot. You are as gabby as the lad I heard today. The fellow whose exploits suggested my original question. The center piece in the incident I intended to relate if given the ghost of a chance."

"Go ahead," said Bill. "Who's stopping you? I only hope the last part of your story is not as long as the first part. You remind me of the lad who said a story or speech should have three parts: A beginning, a middle and an end. The beginning or introduction is of no earthly value. The conclusion usually is tacked on for ornament and is not necessary. The middle may be of some interest to the speaker, especially if he is paid by the hour, but no one else cares a rap for it. Take my tip, young feller, skip the beginning and the end and cut the middle short."

"Pard," I said, in my best frontier style, "you shore could do some skippin' and cuttin' yourself to the benefit, advantage and comfort of this yere assembly. Which the same also was true of the hombre I heard today.

"I wasted nearly half an hour listening to him. About 200 other free and independent citizens helped me, but as they probably had nothing else to do, the net loss of time for the entire party did not exceed the one-half hour.

"There's an example for you of the manner in which figures can be juggled to prove anything the figurer wants to prove. Any good statistical sharp, with one hand behind his back, could prove to you that if 200 men were on the job for half an hour, the total loss of time would be exactly 100 hours. Figures are wonderful things.

"This lad I am telling you about did not quote any figures, but he had the most wonderful gift of any person I ever heard, in contradicting his own statements.

"I wiggled my way within hearing distance to hear him make an impassioned plea for those within the sound of his voice to unite and demand a share of the wealth they had created.

" 'You stand and sit around here all day,' he shouted, 'objects of charity.

Always a Bull on American Prosperity

That's what you are doing, living on charity. You should be ashamed to accept charity from any one. This is a free country with a constitution that claims you have a perfect right to the pursuit of life, liberty and happiness and you have not sense enough to get together and get those things. The capitalists have 'em all and you have nothing.'

"Then he touched upon the late war, the unemployment situation, the impossibility of a man over 40 securing employment, lockouts, strikes, the Mooney case in California, personal experiences in many places including a period he had spent as a guest of the state.

"Some of his statements had a plausible ring, but almost invariably he introduced other statements later which made me wonder if he was mentally unbalanced, or, if he was talking on the assumption that his hearers had no memories. His final remarks led me to decide that the latter assumption was correct.

" 'You know,' he said, 'the privilege of free speech that goes with this rostrum in the public square, does not include the taking up of a collection. I have no intention of getting pinched for abusing that privilege and therefore I shall not pass among you soliciting donations. However, I shall place my hat here on this stand when I descend and I shall appreciate any amount large or small you care to drop into it!' "

"Did you give him anything?" Bill asked.

"On the basis," I said, "that I had derived a certain measure of entertainment from listening to him—he was an easy and fluent talker with a pungent and at times, profane wit—I felt inclined to contribute, but a memory of his early denunciation of all forms of charity restrained me. I feared I might hurt his feelings. Far be it from me to cause a man to violate his principles."

"That fellow," Bill remarked, "has the same kind of principles as the late Payday Tom O'Neil. Tom was a molder, a kind of a wandering Ishmalite who never worked at the trade after he finished serving his time. He knew the payday of every shop in the country and timed his visits to coincide with these various dates. He also knew to a nickel how much it was safe to touch each man in the shop for on these occasions. If he received more than he expected, he earnestly assured the donor that if their positions ever were reversed—which God forbid—his purse was there to command and the shirt off his back was at the service of the party of the second part. Considering the chronic emptiness of the purse and the suspicious character of the shirt, the offer usually was regarded merely as a handsome rhetorical gesture. So far as I know, no one ever asked him to open one or shed the other.

"Where the contribution did not measure up to his forecast, he solemnly shook his head and remarked that the lot of the honest workingman was becoming more difficult every day. He did not know what the world was coming to.

"The last time I saw Tom was in the old G.E., in Schenectady where I was working on a job something like that smokestack I was talking about recently.

"In addition to the methods already described for molding the job in sand, there is another in which the mold is made in loam.

"Where the material and equipment are available, the mold may be swept in loam according to any one of several combinations. In one the inside, or core, is swept in loam with the bottom internal flange formed either in cores or by a finger on the sweep. If—as is probable—this flange is reinforced by a number of small vertical brackets, the core method is the more convenient of the two. This also applies to the upper flange.

"The outside part of the mold is

swept in loam on a lifting plate which converts this part of the mold into a cheek for finishing and drying purposes. If a large flask is available, it may be bricked on the inside and thus converted into a cheek.

"In another arrangement, the outside of the mold may remain stationary and the core can be lifted out on a plate. The usual practice for a mold of this kind is to sweep the outside part of the mold first and lift it away. The outside sweep then is replaced by the inside sweep without disturbing the arm or spindle. This method probably presents less chance for error than where the outside is swept independently on a separate spindle and seat.

"In a third variation of the loam mold, a sweep is employed only to form the core and the seat for the cheek on a suitable foundation plate. Wood lagging strips approximately 2 inches wide and ½-inch thick are placed close together all around the core. They are held in place temporarily with a strand of light wire which encircles the entire assembly and is pulled tight with a pair of pliers. This wire is removed after a few courses of brick have been laid against the lagging strips on the outside. The outside lifting ring plate then is lowered into position and the outside wall of the mold is built directly against the strips. The strips are oiled to prevent them from adhering to the wet loam. After the outside wall has been built and struck off flush with the top of the core, the strips are removed, one at a time. Then the cheek is lifted off and the mold is finished, blacked, dried and reassembled in the usual manner. Where a flask is available, sand may be substituted for the brick wall and loam on the outside of the mold. This sand cheek may be either dried or skin dried.

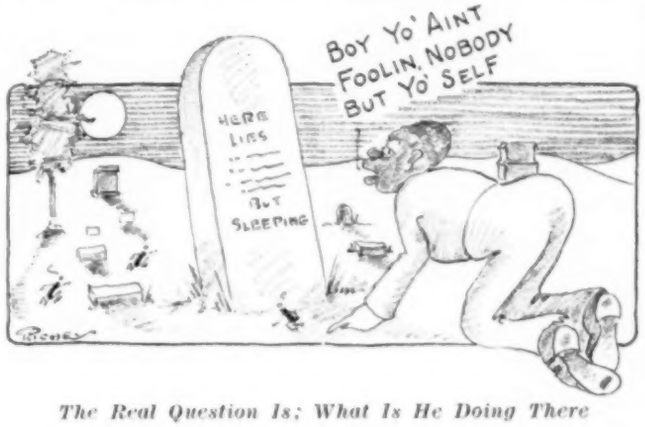
"In still another variation, the outside of the mold may be struck up in loam and dried. The inside is formed with a set of cores as described in the first method of this series. With careful manipulation in removing the casting, the outside wall of the mold will serve for several castings.

"On a thin casting of this kind where the diametrical contraction amounts to approximately ¾-inch, proper precaution must be taken to prevent distortion or cracking. This applies particularly where the interior of the mold is a solid brick wall. The usual method is to build two or three vertical strips of the wall with mud bricks formed of the building loam and dried in anticipation. These wall strips, spaced equidistantly, will crush under the strain and permit the wall to yield.

"In another method, wood or metal strips are built in the wall vertically. The inside edge is separated from the casting by the thickness only of the loam coating. Immediately after the casting has set, these strips are knocked out. In still another method, the brick wall is built fairly open and vertical strips several inches wide are removed with a sharp steel bar after the metal has solidified. The top of the mold is covered with cake cores as in the preceding instances.

"From the foregoing," Bill concluded, "you can see there are as many ways of making this mold as there are ways of killing a cat. This sapient remark also applies to nearly any casting you have a mind to mention.

"The man who thinks there is only one way to make a mold reminds me of the negro prowling through a graveyard, who saw an inscription on a tombstone, 'Here Lies Johnny Holtott, Not Dead, but Sleeping.'



The Real Question Is; What Is He Doing There

"'Golly!' He exclaimed. 'Dat guy shu'ly aint foolin' nobody but his self!'"

Practice Fundamentals

(*Concluded from Page* 114)

shape for the drag is formed first and then thickness pieces of wood, or layers of sand are built against the face to correspond to the desired metal thickness. The cope is rammed as in the preceding case and after it has been lifted the excess sand is removed from the drag.

In a third and more modern method the molder must have a pattern segment with a length of 24 to 36 inches as shown in Fig. 226. A level bed is formed in the bottom of a hole in the floor. This bed should be extended about 4 inches beyond the size of the proposed casting. The outline of the bottom face of the casting is marked on the sand bed and pins are driven at the corners to serve as reference marks.

The square segment Fig. 226 is placed on the bed in such a manner that the lower outside edge coincides with the line marked on the sand.

The segment is weighted so it will not shift and sand is rammed against the outside. The operation is repeated in succession all around the mark until the complete drag mold is formed. Pieces of boards or sand are employed to form the thickness as in the preceding instance.

In some American foundries the inside and outside of the mold are formed by a number of dry sand cores. These cores have a sloping joint which permits fitting them together without guides or check marks. This method permits small foundries which have but light hoisting equipment, to make comparatively heavy molds and castings. The cost of making the core-boxes is comparatively insignificant.

Book Review

Penton's Machine Shop Directory, 1930-31 edition; fabrikoid, 640 pages, 5¼ x 8¼, published by the Penton Publishing Co., Cleveland, and supplied by THE FOUNDRY for $25 plus 15 cents postage.

The first edition of *Penton's Machine Shop Directory* contains data on 5240 companies in the United States and 304 in Canada. The main listing is alphabetical, with a cross index aranged geographically by states and cities. This should be of value to purchasers desiring to use the directory in conjunction with specific sales territories.

Considerable care has been exercised in the selection of companies listed, small and extraneous organizations being omitted from the list. Information presented includes the name and address of each company, principal products, and in most cases the year established, capitalization, number of employes in machine shop and the personnel, both executive and operating. This directory should be of value to many different types of purchasers, since names of such individuals as storekeepers, tool room foreman, chief draftsman, etc., are listed.

Develops Piston Alloy

During the past eight years, the Aluminum Co. of America has been developing an alloy for internal combustion engine pistons which combines light weight, low coefficient of expansion, high thermal conductivity and good bearing properties.

As a result, now they have on the market an alloy of aluminum, nickel, copper and magnesium. The coefficient of expansion of the new piston alloy is said to be identical to that of the cast iron-nickel alloy.

Alexander B. Galt of the simplified practice division department of commerce has announced that the recommendation for malleable foundry refractories has been reaffirmed as it exists at present for another year by the standing committee of the industry.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Selling in a Buyers' Market

SELLERS of castings might well take a lesson from the changing methods of automobile salesmen during the present period of slow business. The prospect for a new car, today, is meeting a new type of salesman, better informed on his product and more aggressive in presenting merits of his car. Further, the glut of used cars has brought about a tightening of price offered on trade-ins, a closer agreement on values of old cars between competitors in the new car field. This in effect amounts to price maintenance in the face of unusual pressure.

SIMILARLY, castings salesmen should stiffen their backbone against the drive for cut prices. The merits of their product, sound castings of definite physical properties, adapted to the users needs by their special attributes, should be drilled into the mind of the prospective buyer. When the subject of price returns again and again, as it will, hold the line and don't cut because a buyer quotes a competing foundry as offering a lower rate. Probably the competitor didn't make such an offer, and if he did and the price is such as will yield no profit, let him have it.

¶ Building with Castings

MANY of the new buildings reaching skyward in New York and other large cities are exceedingly modernistic in design. Architects have succeeded, with the aid of several different kinds of metals, in producing effects most pleasing to the eye. In this modern trend in the building industry, castings are playing a more important role than ever before. This is especially true with cast aluminum, employed extensively for spandrels, mullions, window sills, copings, etc. In addition, the symbolic figures which embellish the tops of many buildings, for example, the new Chicago Board of Trade building, are products of the foundry.

UNDOUBTEDLY, only a start has been made in developing the demand for castings in the architectural field. The fact that intricate designs can be produced in metals only by casting, opens wide possibilities. In the case of aluminum and its alloys, lightness, resistance to corrosion and endurance are important factors which will increase the demand from the building industry for that metal in castings.

¶ Let the Good Work Continue

DURING the past 70 years chemistry has played an important role in steel-making, according to a report presented by Dr. C. H. Herty to the National Research Council Science Advisory committee. The major work has been to formulate methods for the determination of the various substances in steel, and to assist in working out methods for the elimination of harmful material. According to Dr. Herty scientific investigations on steel-making processes may be divided into four fairly definite periods. In the first, from 1860 to 1877, gases received considerable attention since the bessemer and open-hearth processes were coming into use. From 1877 to 1889 the use of lime as a dephosphorizer and the function of both lime and iron oxide in the dephosphorization of steel were studied particularly in England.

USE of maganese to desulphurize pig iron and of lime in the open hearth to desulphurize steel was given considerable attention from 1889 to 1902. Effects of oxygen in steel began to be appreciated and investigated from 1902 to 1912. Shortly before that time Ledebur had developed a method for the determination of oxygen. From 1912 to 1922 further work was done on oxygen and new methods were devised for the determination of oxides. Increasing attention was paid to oxygen in steel from 1922 to 1930 stressing the types of oxygen compounds and the nonmetallic inclusions in steel.

THUS it easily can be seen why steel, though almost a youngster compared to gray iron, has made such rapid progress. Since its inception, considerable study and investigation have been devoted to the problems of steel production, and many of the problems have been overcome, but research still goes on. However, although it is comparatively recently that gray iron is receiving the same sort of attention, definite progress is being made, and before long data comparable to that on steel should be available.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

WILLIAM G. FERBER has resigned his position as foundry superintendent, Pennsylvania Bronze & Brass Co., Philadelphia, and has accepted a similar position with Cramp Brass & Iron Foundries Co., of the same city. Mr. Ferber also has been associated with the Worthington Pump & Machinery Corp., Harrison, N. J. and with the Allis-Chalmers Mfg. Co., Milwaukee. He occupied the position of foundry foreman at the latter plant.

B. Charles Warthen has been made purchasing agent for Beaumont Iron Works Co., Beaumont, Tex. E. J. Roach, formerly shop superintendent has been appointed plant manager for the company.

James B. Hamilton, for the past 13 years connected with Ford Motor Co., Detroit, recently resigned his position and now is in Russia working for the Soviet government at the tractor plant in Stalingrad. The plant is one of the new industrial enterprises of the Russian government.

M. J. Walsh, for the past 38 years connected with the James Leffel & Co., Springfield, O., has retired from active service. Mr. Walsh began his career as a molder with the company in Oct. 1892 and was promoted to the foundry foremanship in 1912.

Walter Kneeland has joined the roll sales department of Wheeling Mold & Foundry Co., Wheeling, W. Va. Mr. Kneeland was formerly with United Engineering & Foundry Co., Pittsburgh, and Youngstown Foundry & Machine Co., Youngstown, O.

Fred Griffiths has resigned as manager of roll sales, Mackintosh, Hemphill Co., Pittsburgh, to assume the position left vacant by H. A. Lomax in the Duquesne Steel Foundry Co., Pittsburgh. Mr. Griffiths has been identified for a number of years with Mackintosh, Hemphill Co. in both production and sales activities and was formerly with A. Garrison Foundry Co., now a Mackintosh, Hemphill Co. subsidiary.

Dr. C. H. Lorig, professor of mechanical engineering in charge of metallurgical courses, Drexel institute, Philadelphia, has become affiliated with the technical staff, Battelle Memorial institute, Columbus, O., where he will study foundry and general metallurgical problems. He had previous experience with Wisconsin Steel Co., Chicago; Wisconsin Appleton Co.; French Battery Co., Madison, Wis.; Ladish Drop Forge Co., Cudahy, Wis.; and at the University of Wisconsin, Madison, Wis., where he engaged in engineering research, and where he received undergraduate and graduate degrees.

Aluminum Institute Will Standardize Analyses

Aluminum Research institute, Chicago, has began a cooperative effort to standardize the methods of analyzing aluminum alloys. In the past consumers of aluminum ingot have been confused and inconvenienced by receiving the results of analyses by laboratories of aluminum ingot samples which did not closely check with the analyses reported by the smelters. Upon investigation, it usually was found that the methods of analyses used by the laboratory and the smelter varied in important particulars.

On June 30th, the chief chemists of the members of the Aluminum Research institute met with the chief chemist of a commercial laboratory. The standard practices that are currently used by the commercial laboratory and by members of the institute have been exchanged and are now being critically studied.

When standard methods of analyses have been agreed upon and adopted they will be printed and made available for distribution to any commercial or plant laboratory which desires to obtain copies. After an agreement has been reached within the Aluminum Research institute upon standard methods of analyses, the various interested technical organizations will be invited to consider the procedure with view to its approval and adoption.

Book Review

The Aluminum Industry, by Junius D. Edwards, Francis C. Frary, and Zay Jeffries, in two volumes, cloth 358 and 870 pages respectively, 5¾ x 9 inches, published by McGraw-Hill Book Co., New York, and supplied by THE FOUNDRY, Cleveland, for $12.15, and in London by the Penton Publishing Co., Ltd., Caxton House, Westminster.

While the discovery of metallic aluminum is a little over 100 years old, real progress in its production on a large scale goes back only 40 years, or to the development of the Hall process. The early investigations on the production of aluminum, and the trials and tribulations of inventor Hall are ably described in the first two chapters of the first volume which is sub-titled, "Aluminum and Its Production." The other seven chapters deal with the aluminum industry in Europe, ores of aluminum, production of alumina, acid processes for the extraction of alumina, electrothermal and miscellaneous furnace processes, materials for the reduction process, and the production of aluminum.

The second volume contains 20 chapters relating to the properties of aluminum and its alloys, the fabrication of aluminum products, and their uses in industry, and is subtitled, "Aluminum Products and Their Fabrication." Information on rolling, drawing and extrusion is outlined, but casting, machining, etc., are treated in greater detail. The first chapter is devoted to the commercial history and the second to the physical and chemical properties of aluminum. Other chapters relate to constitution and structure properties; commercial alloys; melting; casting; working; heat treatment, riveting, welding and soldering; and coating and finishing. The remaining eleven chapters show the uses of aluminum and its alloys.

Gives Equipment Orders

The index of gross orders for foundry equipment for July showed 90.6 as compared to 102.6 for June, according to a recent report of the Foundry Equipment Manufacturers association. The index for shipments dropped from 160.5 in June to 116.1 in July. Unfilled orders also declined from 166.7 in June to 139.1 in July. The base is the average monthly shipments for the years 1922-23-24. Comparison of gross orders as given by the Foundry Equipment Manufacturers association follow:

	1927	1928	1929	1930
Jan.	180.4	132.7	180.5	160.1
Feb.	198.0	123.6	197.0	196.4
Mar.	131.1	138.6	209.4	164.1
Apr.	130.1	107.7	172.6	122.8
May	13.8	325.6	177.7	92.7
June	138.4	149.1	177.3	102.1
July	89.9	94.8	218.6	90.6
Aug.	106.4	278.0	229.5	.....
Sept.	80.4	170.0	216.3	.....
Oct.	98.0	185.0	245.3	.....
Nov.	95.8	197.8	128.6	.....
Dec.	106.8	166.5	208.0	.....

Gives Relationships

The bureau of standards recently published *Research Paper* No. 185 on the "Relationships Between Rockwell and Brinell Numbers," by S. N. Petrenko which supersedes a similar paper published in 1927. From the investigations carried out, six equations were developed and curves plotted. Recommended range of application of each conversion curve is given.

OBITUARY

James C. Davis, formerly fourth vice president in charge of operations of the American Steel Foundries, Chicago, and more recently advisory vice president in charge of operations, died Aug. 10 at Mackinac Island. He was a pioneer in the steel casting industry and was the inventor of the cast steel wheel with a soft center and a wear resistant rim. He was connected with the Sargent Co., Chicago, for 17 years. In 1896, he was appointed general superintendent in charge of operations for that company. He resigned in 1901 to accept a similar position with the Leighton & Howard Steel Co., St. Louis. When the two companies were absorbed by the American Steel Foundries in 1902, he was appointed western district manager. In June 1905, he was appointed assistant to the first vice president in charge of operations at Chicago. In

James C. Davis

1912, he was made fourth vice president in charge of foundry operations and in April 1929 became advisory vice president in charge of operations, a position he held until his recent death.

Walter S. Bickley, formerly president, Penn Steel Castings Co., Chester Pa., died July 23 at his home in Swathmore, Pa. He was 63 years old and had been ill for the past two years. He had been inactive in business for several years.

Martin J. Yocum, from 1900 to 1921, secretary of the Harnischfeger Corp., Milwaukee, died Aug. 1. He was 68 and has not been active in business since his retirement from the Harnischfeger Corp.

Frank Blacketer, formerly operator of the Long Beach Brass Foundry, Long Beach, Calif., died recently at his home in Santa Ana, Calif.

Fred Dias, formerly connected with the Western Stove Co., Culver City, Calif., and more recently with the Advance Bronze & Aluminum Foundry, Los Angeles, died recently at Oakland, Calif.

Foundry Association Directory

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. Bonner, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. Evans, Continental Roll & Steel Foundry Co., East Chicago, Ind.; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, William J. Muhlitner, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Assistant Director, C. N. Ring; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, Walter L. Seelbach, Forest City-Walworth Run Foundries Co., Cleveland; secretary, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue.

Newark Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting dates: Oct. 22; Dec. 3; Jan. 28; March 25; May 27.

New England Foundrymen's Association

President, Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.; secretary Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland. Annual meeting in October.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. Troutman, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad City Foundrymen's Association

President, R. L. Eichman, Bettendorf Co., Bettendorf, Ia.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, Horace R. Culling, Carondelet Foundry Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. Orphan, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, Edward C. Gustin, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

Flexible Shaft Machines Have New Features

United States Electrical Tool Co., Cincinnati, has made several changes in its flexible shaft equipment. One of the features is the v-disk speed changer shown in the accompanying illustration. That apparatus provides eight different speeds for the machine ranging from 1000 to 11,000 revolutions per minute and makes available the proper speed for the tool being used. The company supplies a chart with each flexible shaft machine which tells the correct operating speed for different tools used on various metals.

Both shaft and casing have been made more flexible. The casing expands and contracts, absorbing the tension and compression thrown on the shaft. That feature is claimed to be an important advantage because it eliminates the necessity of the shaft slipping to and from the motor while under power. Stress is relieved further by a slide coupling at the motor end of the casing. The shaft is made of cold-wound, piano wire and is fastened rigidly to the motor. It is well lubricated and a coil bearing has been inserted between the shaft and the casing. The hand piece turns on ball bearings in a grease-tight compartment.

Eight Different Speeds Are Provided for the Machine

Markets Electric Heater

American Foundry Equipment Co., Mishawaka, Ind., recently introduced a new type electric heater. The unit combines the characteristics of both steam and electric unit heaters. Special alloy heating strips are cast integrally with composite fins of aluminum alloy making a single casting that will allow air to flow through its channels. The castings are assembled in a cabinet and a fan, mounted at the rear of the cabinet, circulates air through the heated fins. The unit may be temporarily or permanently installed and is applicable to heating temporary or isolated buildings, for intermitent heating in warm climates, for plants generating their own power or for those whose power rate is low, etc.

Designs V-Belt Drive

A new multiple, v-belt drive has been added to the products made by the Worthington Pump & Machinery Co., Harrison, N. J. The drive consists of a number of endless, molded v-belts running in v-grooved sheaves. It was developed in conjunction with the Goodyear Tire & Rubber Co., Akron, O., which makes the belts used on the drive. The load carrying members of the belts are cotton cords arranged in parallel lines and concentrated about the neutral axis. The new drive is built to take advantage of the transmission characteristics of the v-belt type drive which result from the wedging action between the belts and the grooves.

Redesigns Bench Sander

Porter-Cable Machine Co., Syracuse, N. Y., has placed on the market a redesigned model of its oscillating spindle, bench sander, shown in the accompanying illustration. The new tool is applicable to various kinds of curved, irregular and angular internal work on wood or metal and is adapted to patternshop work.

Among the changes made in the machine, the old motor has been replaced by one of ¼ horsepower of the repulsion induction type designed for either 110 or 220 volt power. The motor shaft is longer than in the former model and extends through the spindle. A ¾-inch steel sliding sleeve fits this spindle and is driven by the motor shaft which is square at the top. This construction eliminates key or keyway wear.

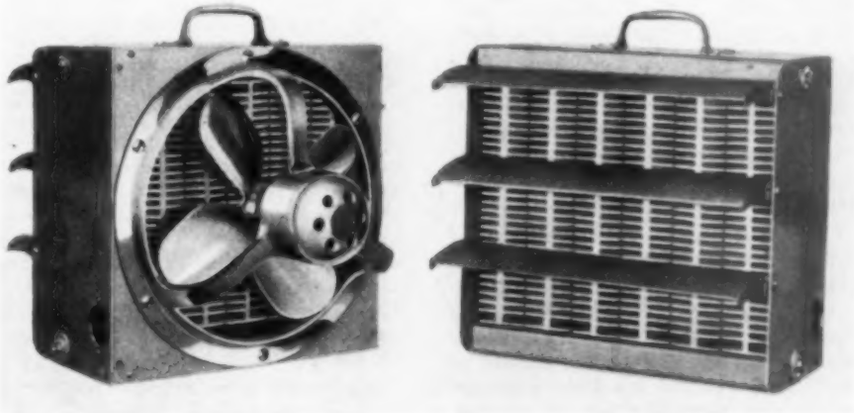
The table is supported by a segment for giving it an accurate center. The segment is graduated in degrees and allows the table to be tipped 45 degrees from the horizontal. The tipping feature is of value in getting accurate drafts. The spindle oscillates 90 times per minute and has a ½-inch travel. It revolves at the same speed as the motor, 1725 revolutions per minute. The entire machine is of ball bearing construction including the motor and oscillating trunion.

A Sturdy Motor Features New Bench Sander

Machine Operations Are Controlled Centrally

Tabor Mfg. Co., 6225 Tacony street, Philadelphia, has introduced a new type plain-jar, roll-over, pattern-draw, molding machine in which operations are controlled centrally. The roll-over plate is 18 x 28 inches with an 8-inch pattern draw. It is equipped with quick acting air clamps and cradle elevator. The rolling operation is air-on-oil controlled and the machine is guarded against breakage in case of pipe line failure.

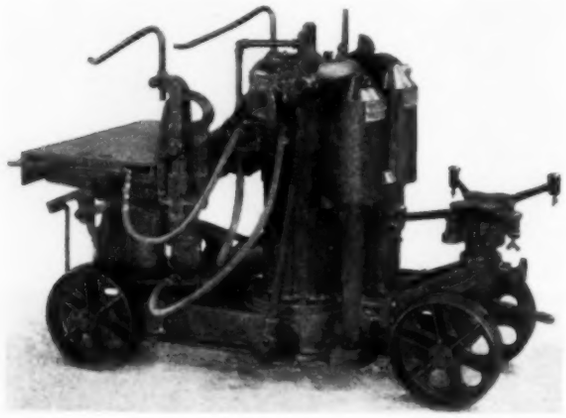
The pattern drawing operation also is controlled by air-on-oil. The cradle elevator is supported on ball bearings which are incased and protected from sand. The ball bearings require no lubrication. The leveling device is automatic. With the mold rolled into



A Motor Driven Fan Circulates Air Through the Heated Fins

the pattern-drawing position, the cradle elevator is raised. When the leveling device makes contact with the mold, the cradle elevator stops automatically with the leveling device locked in position. Air operated flask clamps are provided which are said to be practically instantaneous in operation.

Clamping, unclamping, rolling-over, pattern-drawing and rolling the mold back into position all are controlled from the pipe stand. That method of construction is claimed to reduce the effort of the operator and to speed production. It also is claimed that the machine is economical in the use of compressed air.



The Machine Is Equipped with Ball Bearings

New Type Vibrators Are Light Weight

Osborn Mfg. Co., 5401 Hamilton avenue, Cleveland, has introduced a new line of vibrators which feature increased power, light weight, economy of air consumption, increased resistance to wear, freedom from sticking, easy lubrication and greater dependability. Matchplate vibrators are made in ⅝, ¾, and 1-inch sizes. Other sizes include 1, 1¼, 1⅝, 2, and 2½-inch. Matchplate vibrators are designed so that the exhaust ports are in a horizontal position when sand is being riddled or when the molding machine is jolting. They have forged, steel bodies: machine, steel body plugs with hardened, steel, piston stops; chrome-vanadium, steel springs; and hardened and ground steel pistons. The 1 and 1¼-inch types are of similar construction to the matchplate vibrators except that they are made for two bolt mountings.

The machines are constructed of sturdy material and are designed to stand up under heavy production.

The 1⅝-inch type is applicable especially to high production molding machines. The body is made of cast semisteel and the body caps are ribbed cast steel and held in position by four through-bolts. Oil inlets are located conveniently. The two larger sizes are constructed with the same materials as the previously mentioned vibrators and may be utilized on large molding machines, sand bins, chutes and elevator boots. In addition to the types mentioned, the company also manufactures 2 and 2½-inch end mounting vibrators which embody the same construction as the larger sizes previously mentioned.

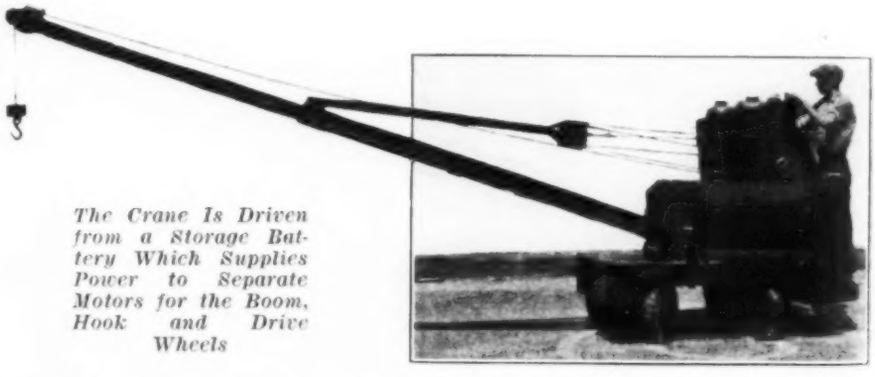
Electric Crane Turns in Short Radius

A new type, heavy duty crane, suitable for indoor or outdoor use, recently was placed on the market by the Terminal Engineering Co., New York. The crane, shown in the accompanying illustration, is adapted to uses where crowded conditions make easy maneuverability a vital point, and in jobs where it is necessary to have a long reach horizontally as well as vertically.

The capacity of the crane is 3650 pounds at a distance of 2 feet from the end of the chassis, or 750 pounds at 14 feet from the end of the chassis. The boom is telescopic over a distance of 6 feet. The boom and hook are operated independently from two separately driven hoist units, each with its own motor and controller.

The truck uses a four-wheel drive with no mechanical differentials, but with a motor on each wheel. The machine is designed to concentrate as much weight as possible over the wheels away from the load. However, in cases where the load is great enough to throw nearly all the weight on the wheels near the hook, the four wheel drive is designed to provide sufficient traction. Power is supplied to the crane and drive motors from a storage battery which also may be used to operate an electromagnet.

The maximum height of lift is 17 feet, 6 inches, on the standard model. The machine can pass through 72-inch doorways when the boom is lowered. The turning radius to the outer corner of the truck is 5 feet, 3 inches.



The Crane Is Driven from a Storage Battery Which Supplies Power to Separate Motors for the Boom, Hook and Drive Wheels

Returns from Trip

E. J. Byerlein, general manager, Milwaukee Foundry Equipment Co., Milwaukee, returned from a trip around the world recently. He left Milwaukee Feb. 12 and, after touring the west coast, sailed from San Francisco, Feb. 19, for New Zealand where he spent two weeks. From there he sailed to Australia where he spent a month and a half. He reported that business there was considerably worse than in this country. Mr. Byerlein continued on to Ceylon, Port Sudan, Port Said, Malta, Marseilles, Paris, Prague, Berlin and London.

Complete Safety Code

A new edition of the code for lighting factories, mills and other work places has been completed by the American Standards association and has been approved by its sponsor, the Illuminating Engineering society. Many recommended values and specifications for illumination for different kinds of work have been changed. Revisions also have been made in the discussion of the advantages and methods of securing good lighting. The code is being considered by the standards council of the American Standards association for approval.

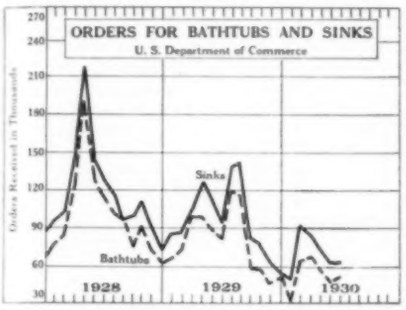
Pacific division, Link-Belt Co., Chicago, has moved into its new plant and office at Paul avenue near Bayshore highway, San Francisco.

Trade Trends in Tabloid

BUSINESS sentiment continues to improve although little change has been noted in actual conditions during the past fortnight. It is believed that the rains which have fallen over portions of the drought area will reduce losses anticipated several weeks ago and will benefit greatly the manufacturers of agricultural implements.

—T—T—

Tractor manufacturers and foundries specializing in automobile castings in the St. Louis district report heavier orders. Aside from road



building and maintenance machinery, which continues active, business among machinery and engine makers is not impressive. Shipments of stoves to date represents the smallest total for the similar period in recent years.

—T—T—

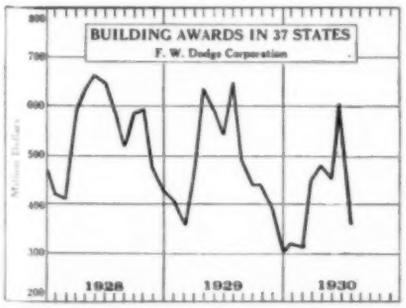
Construction contracts awarded during July in the 37 states east of the Rocky Mountains were valued at $367,528,400, according to the F. W. Dodge Corp. This represents a decline of 39 per cent from the total of $600,573,400 in June. However, orders for fabricated structural steel gained in July and industrial building awards rose materially.

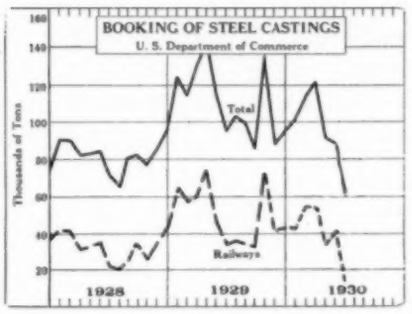
—T—T—

Steel mill operations were 55.5 per cent of theoretical capacity the third week in August, compared with 58.5 per cent two weeks previous. The former represents the lowest point reached this year.

—T—T—

July freight car awards totaled 1348 units, compared with





2998 during the preceding month and 341 in July, 1929. Awards for the month gave the highest total for any corresponding month during the past seven years, with the exception of July, 1927. However, buying in April, May and June of this year was far below normal.

—T—T—

Foundry operations in the Chicago district remain at 40 to 50 per cent. Virtually no change has occurred since Aug. 1, except that brass foundries have been getting a few more orders. Several of the gray iron jobbing shops are in a better position because customers have released shipments of some tonnages of castings that have been held up because of slack business. Steel foundry operations are a shade better.

—T—T—

Production of malleable castings in July slipped to the lowest point of the year, with a total of 31,099

RAW MATERIAL PRICES
August 20, 1930

Iron		
No. 2 foundry, Valley		$18.00
No. 2 Southern, Birmingham		14.00
No. 2 foundry, Chicago	$17.50 to	18.00
No. 2 foundry, Buffalo		18.50
Basic, Valley		8.00
Basic, Buffalo		18.00
Malleable, Chicago	17.50 to	18.00
Malleable, Buffalo		19.00
Coke		
Connellsville beehive coke	$3.50 to	4.85
Wise county beehive coke	4.25 to	5.00
Detroit by-product coke		8.50
Scrap		
Heavy melting steel, Valley	$15.00 to	15.50
Heavy melting steel, Pitts.	15.00 to	15.75
Heavy melting steel, Chicago	12.00 to	12.25
Stove plate, Buffalo	10.25 to	10.50
Stove plate, Chicago	9.50 to	10.00
No. 1 cast, New York	9.50 to	9.75
No. 1 cast, Chicago	12.00 to	12.50
No. 1 cast, Philadelphia		13.50
No. 1 cast, Pittsburgh	14.00 to	14.50
No. 1 cast, Birmingham	12.00 to	13.00
Car wheels, iron, Pittsburgh	15.00 to	15.50
Car wheels, iron, Chicago	13.50 to	14.00
Railroad malleable, Chicago	13.50 to	14.00
Agricultural mal., Chicago	12.25 to	12.75
Malleable, Buffalo	15.00 to	15.50
Nonferrous Metals		**Cents per pound**
Casting, copper, refinery		10.87½
Electro, copper, producers	11.00 to	11.12½
Straits, tin		30.00
Lead, New York		5.50
Antimony, New York		7.75
Nickel, electro		35.00
Aluminum, No. 12, producers		22.00
Aluminum, No. 12, remelt	14.00 to	15.00
Zinc, East St. Louis, Ill.	4.30 to	4.35

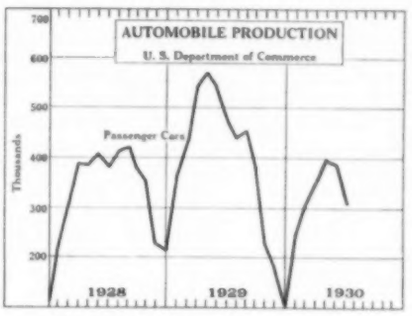
tons, according to the department of commerce. However, orders increased from 33,961 tons in June to 34,731 tons in July.

—T—T—

Loadings of revenue freight cars for the week ended Aug. 9 totaled 904,157 compared with 918,335 cars the preceding week and 1,092,153 cars the corresponding week in 1929.

—T—T—

The National Automobile chamber of commerce estimates that automobile production in July totaled 275,298 cars. This is the lowest total



for any corresponding month since 1923. Production in June was 350,565 cars and in July, 1929 the output was 518,301 cars, according to the department of commerce.

—T—T—

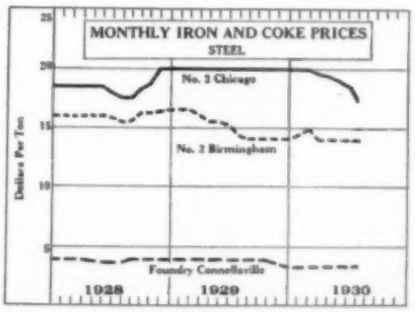
Makers of steel mill equipment in the Pittsburgh territory have enjoyed a busy first half and have a favorable outlook for the remainder of the year. Business in rolls has been poor, due to light operations in finishing mils.

—T—T—

Foundry operations on the Pacific Coast are below normal with business spotty. Business is not recovering from the midseason depression as rapidly as was expected.

—T—T—

Shipments of railroad locomotives in July totaled 56 compared with 81 in June, according to the department of commerce. Shipments for the first seven months of the year amounted to 475 compared with 388 during the corresponding period last year.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Crane Co., Chicago, has reopened its foundry at Chattanooga, Tenn.

Flint Foundry Co., Marshall, Mich., recently was damaged by fire to the extent of $800.

Vernon Foundry, Hollydale, Calif., has added some molding equipment to its foundry.

Empire Steel Castings Co., Reading, Pa., reports that business is increasing.

Brillion Iron Works, Brillion, Wis., has purchased an electric furnace for production of gray iron castings.

Plant of Illinois Malleable Iron Co., 1801 Diversey avenue, Chicago, recently was severely damaged by fire. Loss is estimated at $25,000.

Blanchard Foundry, Twenty-second street, Saskatoon, Sask., recently was damaged by fire. Loss is estimated at $2000.

First quarter profits of the American Steel Foundries, Chicago, decreased 15.7 per cent below that of the same period last year.

General Steel Castings Co., Eddystone, Pa., had a net profit of $1,103,121 for the first six month period of 1930.

Crystal Lake Foundry, Crystal Lake, Ill., has begun operations and will manufacture brass, bronze and aluminum castings.

Hughes Tool Co., Houston, Tex., has a building permit for a pattern shop 72 x 168 feet, which will cost about $38,000.

Alloy Steel & Metals Co., 1862 East Fifty-fifth street, Los Angeles has increased the molding machine equipment in its foundry.

Trinity Valley Iron & Steel Co., 2100 Gandy street, Fort Worth, Tex., has increased its capital from $10,000 to $100,000.

Plant of Canada Iron & Foundry Co., Hamilton, Ont., owned by Canadian National railways, recently was severely damaged by fire at a loss of $100,000.

Hill Clutch, Machine & Foundry Co., West Sixty-fifth and Breakwater avenue, Cleveland, has taken an option on the right to manufacture a clutch device developed in Sweden.

Baker-Nagle Foundry Co., Belleville, Ill., has a building permit for a shop to cost $1200. Bauer Brothers Construction Co. has been awarded the contract.

Utilatree Products Inc., Columbia, Pa., has been incorporated with $25,000 capital by H. Nelson Albright to manufacturer and deal in castings, novelties and art goods.

Mount Vernon Furnace & Mfg. Co., Mt. Vernon, Ill., has purchased the plant of the Universal Stove Co. Inc., St. Louis, and is moving the plant to Mt. Vernon.

Plant of Torrington Castings Co., Torrington, Conn., operator of a brass foundry, recently was virtually destroyed by fire. Estimated loss, $20,000.

Standard Pattern Works, 1208 Queen City avenue, Cincinnati, will build a new plant on Spring Grove avenue at a cost of about $10,000. Howard McClorey, Fourth and Main streets, architect, is taking bids.

Huntman Engineering Corp., Newark, N. J., has been incorporated by Pilgrim & Ritger, attorneys, 43 Lincoln Park avenue, to operate a business as brass founders.

Haynes Stellite Co., Kokomo, Ind., has completed its new foundry unit which will be used for the production of castings resisting the action of hydrochloric acid and wet chlorine. (Noted Aug. 15.)

Storage shed of Harrisburg Mfg. & Boiler Co., Harrisburg, Pa., recently was damaged by fire, and patterns valued at $40,000 were destroyed. Company manufacturers boilers, castings, tanks and stills.

Segal Lock and Hardware Co. Inc., 159 Leonard street, New York, which some time ago purchased the Norwalk Lock Co., Norwalk, O., will remove its entire Brooklyn, N .Y., plant to Norwalk and concentrate lockmaking activities there. Over 200 employes will be added.

Adelphia Bronze & Aluminum Foundry Inc., Philadelphia, has been incorporated with $10,000 capital by Edwin A. France, 6933 Tulip street, Tacony, Pa., to manufacture and sell bronze, aluminum and similar products.

Pacific Foundry Co., has moved from 2418 Fifty-third street, to 718 East Sixty-first street, Los Angeles. The plant now operated by the Pacific company formerly was occupied by Emmett & Sons which discontinued operations following the recent death of W. W. Emmett.

Moline Iron Works, Moline, Ill., has elected L. E. Nutt president, B. V. Nutt vice president, M. C. Nutt vice president and secretary and J. T. Miles treasurer. Directors elected are William Butterworth, Sol Hirsch, J. T. Miles, Ed Miles, L. E. Nutt, B. V. Nutt, M. C. Nutt, C. R. Rosborough and James F. Walsh.

Ruselite Co., in care of the Milwaukee Die Casting Co., 291 Fourth street, Milwaukee, has been organized to produce die castings from an alloy containing chromium, molybdenum and aluminum. Metal is being made at the plant of the Milwaukee Die Casting Co. No new construction is planned.

Stover Mfg. & Engine Co., Freeport, Ill., has taken over the Swartz Mfg. Co., Inc., Freeport, manufacturer of automotive engine pistons. Extensions will be made to the plant of the latter company. Officials of the Swartz company are in charge of the automotive division of the former firm. R. M. Bennethum is president of the Stover company.

Land, buildings, machinery and equipment of the Syracuse Perfection Castings, Inc., Erie boulevard and Geddes street, Syracuse, N. Y., successors to the Smith Wheel, Inc., were scheduled for public auction Aug. 26.

Net profit of the American Machine & Foundry Co., New York, and its subsidiaries, for the six months ending June 30, was $1,588,229 against $1,076,685 for a similar period in 1929.

Canadian National railways, Board of Trade building, Montreal, Que., has awarded contract to St. George Construction Co. Ltd., 4820 Fourth avenue, Rosemond, Que., for a foundry and pattern shop at Point St. Charles, Que. Cost is estimated at approximately $150,000.

Wheatley Bros. Foundry & Machine Co., Tulsa, Okla., now is in production at its new plant on Sand Springs road. New buildings completed include machine shop, 85 x 160 feet, and brass foundry, 40 x 85 feet. Company manufactures oil field pipeline and production equipment, including an all steel gate valve. Thomas Wheatley is vice-president and general manager.

Trade Publications

CONVEYOR DRIVE—H. L. Caldwell & Sons Co., Chicago, has issued a catalog of its screw conveyor drive units. Illustrations of the equipment are given and engineering drawings and data are included.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued recent bulletins as follows: Atomic-hydrogen arc welding equipment; mechanical drive turbines; semi-automatic, reduced-voltage starters; thermostats; selsyns; synchronous motors; automatic full-voltage controllers; oil circuit breakers; photo-electric relays and air drawing-ovens.

INDUSTRIAL HEATING—Skinner Bros. Mfg. Co. Inc., St. Louis, has issued a bulletin on the control of heat and heating costs by the use of its system and equipment in industrial and building installations. Illustrations and diagrams show the principles involved and the equipment employed.

ELECTRIC MOTORS — Fuerst-Friedman Co., Cleveland, has issued a bulletin describing electric motors manufactured by the Diehl Mfg. Co., electrical division, Singer Mfg. Co., for which it recently has taken over sales. Illustrations show construction and general appearance of the motors.